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Integrating IBM Sterling Control Center with Google Cloud Platform for Better Monitoring and Management of Real Time File Transfers

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ABSTRACT

In many organizations, especially those dealing with financial data, healthcare records, or large-scale logistics, file transfers happen constantly and carry critical information. IBM Sterling Control Center has been used widely to handle these file movements and ensure they are completed securely. However, the default monitoring capabilities in such systems are often limited when it comes to real-time analysis, custom alerts, and visual dashboards.

This paper presents an integration approach that connects IBM Sterling Control Center with Google Cloud Platform to improve how businesses can monitor and manage file transfers. The integration uses a combination of technologies including IBM MQ, Google Pub Sub, Dataflow, BigQuery, and Looker Studio. Events from Sterling are captured and streamed into Google Cloud, processed in near real time, and displayed through user-friendly dashboards. This setup helps technical teams detect problems earlier, understand trends, and respond faster to issues. The system was tested under realistic conditions and showed better responsiveness and visibility compared to traditional methods. This paper provides a practical solution that combines on-premise tools with cloud technologies to build smarter and faster monitoring for file transmissions.

1. INTRODUCTION

In today's enterprise environments, file transfer systems play an important role in moving data from one system to another. Whether it's financial transactions, customer records, or regulatory data, these files need to be delivered securely and on time. IBM Sterling Control Center is one of the tools many companies use to manage such file transfers. It helps keep track of transfer statuses, sends alerts, and logs activity for audit purposes. While it is effective in managing these workflows, its reporting and monitoring capabilities often feel outdated when compared to modern cloud-based solutions.

Most businesses are moving toward real time dashboards, automated alerts, and smarter analytics. Cloud platforms like Google Cloud provide strong tools for these needs, including stream processing, real time data pipelines, and customizable dashboards. The problem is that IBM Sterling, being a legacy tool, does not connect easily with these modern cloud services. As a result, teams often have to rely on static reports, manual checks, or limited in-built dashboards to track file transfer status.

This research paper addresses that gap by designing and implementing an integration between IBM Sterling Control Center and Google Cloud Platform. The idea is to build a pipeline that captures real-time events from Sterling, sends them to Google Cloud through Pub Sub, processes them using Dataflow, stores them in BigQuery,

and finally displays useful metrics in Looker Studio. The goal is to give technical teams better visibility, quicker alerting, and more insights into how their file transfer systems are performing.

The approach taken in this paper is simple, practical, and based on technologies available as of 2020. It does not require major changes to the existing setup and works alongside the current Sterling installation. The rest of this paper will walk through similar integration efforts in other organizations, explain how the proposed system was built, show the results of testing it in a real-world scenario, and discuss the benefits and challenges of using cloud tools to improve legacy systems.

2. RELATED WORK

File transfer monitoring has been a longstanding requirement in enterprise data management, particularly in sectors where regulatory compliance, security, and auditability are central. Industries such as finance, government, retail, and healthcare regularly exchange sensitive and time-critical files, and these organizations have historically relied on Managed File Transfer solutions to facilitate this exchange. Among these, IBM Sterling Control Center remains one of the most widely deployed platforms for managing file-based integrations. It offers support for a variety of transmission protocols and provides basic operational monitoring, audit trails, and alerting functionalities. However, as enterprise IT infrastructure has evolved, especially with the growing adoption of cloud platforms and event-driven systems, limitations in the native monitoring capabilities of Sterling Control Center have become increasingly apparent.

Traditionally, administrators monitored file transmissions using Sterling's inbuilt dashboards or by manually reviewing operational logs. These dashboards, while functional, are often rigid and limited in customization. Moreover, the interface tends to rely on scheduled refreshes rather than live updates, which introduces latency and inhibits real time decision-making. For larger enterprises dealing with thousands of file transmissions per hour, this delay can lead to increased resolution times, missed service-level agreements, and potential financial penalties. As a result, many organizations have sought ways to improve observability and responsiveness by integrating Sterling with third-party monitoring tools.

One common approach in industry has involved extracting Sterling logs or MQ events and ingesting them into centralized log management solutions such as the Elastic Stack, Splunk, or IBM QRadar. These platforms provide greater flexibility for searching logs, visualizing trends, and creating custom dashboards. However, they often operate on historical data and may not support true real time analytics without additional customization. In many cases, these tools were designed to serve general-purpose log analysis and were not tailored to the unique characteristics of file transfer workflows, such as transmission retries, SLA enforcement, and multistage routing across partners and systems.

Another stream of work has focused on integrating file transfer systems with business process management and orchestration tools, such as MuleSoft, Dell Boomi, or IBM Integration Bus. These platforms support various protocols and connectors, and allow for complex workflows to be built around file ingestion, transformation, and delivery. However, the adoption of such platforms often requires organizations to rearchitect their existing transfer processes or move away from Sterling entirely, which can be costly and disruptive for mission-critical environments.

In academic literature, most research in monitoring and observability has focused on application performance, web service monitoring, or cloud-native telemetry. For example, studies in cloud computing have examined the use of real time analytics pipelines to track user behavior, error logs, and service health across distributed systems.

These pipelines typically involve technologies such as Apache Kafka, Apache Flink, Apache Beam, and cloud messaging systems like Amazon Kinesis or Google Cloud Pub Sub. While these solutions demonstrate impressive scalability and speed, they are rarely applied directly to file transfer systems, particularly legacy ones such as Sterling.

Some academic research has explored log mining and anomaly detection for identifying failures in batch processes and middleware operations. Techniques such as sequence mining, clustering of event logs, and rule-based correlation have been proposed for root cause analysis. However, such studies usually assume access to structured log data and do not address the integration challenges of bridging on-premise infrastructure with cloud platforms. Moreover, the focus is often on web service flows rather than file-based transfers that have unique operational characteristics, including large payload sizes, multiple protocol hops, and rigid delivery windows.

In recent years, cloud service providers have introduced a range of observability services aimed at supporting real time monitoring and alerting. Google Cloud Platform, in particular, has made significant advances with its Pub Sub service for message ingestion, Dataflow for stream processing, BigQuery for analytics, and Looker Studio for visualization. These services are increasingly used for telemetry collection, log processing, and real time event pipelines across a wide variety of domains including e-commerce, IoT, and infrastructure monitoring. There is strong evidence that combining such services into an integrated observability stack can dramatically improve responsiveness, system visibility, and reliability. However, the application of these tools to legacy enterprise systems such as IBM Sterling Control Center remains relatively unexplored in both industry and academic circles.

A few commercial whitepapers and case studies have suggested early-stage integrations between IBM MQ and cloud-based processing platforms, but these are typically vendor-specific and lack the technical detail or openness required for replicable research. Furthermore, there is little to no publicly documented work showing a complete integration of IBM Sterling with Google Cloud Platform using a fully event-driven approach. Most examples stop at log ingestion or periodic file polling rather than streaming file transfer metadata in real time.

This paper contributes to the literature by filling this critical gap. It presents a working implementation of a near real time monitoring system that connects IBM Sterling Control Center to Google Cloud services. The solution captures file transfer events directly from IBM MQ, transforms and enriches them using Apache Beam on Dataflow, stores them in BigQuery, and visualizes them in Looker Studio. This is done without replacing the existing Sterling infrastructure, making the approach non-disruptive and cost-effective.

Moreover, the integration is designed using services and tools that were readily available and production-stable as of 2020, making it applicable for immediate adoption. By documenting the technical architecture, pipeline components, processing logic, and evaluation results, this research provides a practical and reproducible model for other organizations seeking to modernize their file transfer monitoring strategies. It combines lessons learned from log analysis, cloud telemetry, and hybrid IT management, and applies them to the relatively underexplored area of managed file transfer observability.

The novelty lies not only in the combination of tools, but in the specific context of real time operational intelligence for file-based systems. This has practical implications for improving SLA adherence, reducing incident response time, and enabling predictive monitoring in data-heavy environments.

3. SYSTEM ARCHITECTURE

The proposed architecture is designed to connect an on-premise deployment of IBM Sterling Control Center with the real time data processing and monitoring services provided by Google Cloud Platform. This integration aims to achieve continuous visibility into file transfer events by capturing them as they happen, transforming them into a standardized format, and making them available for analytics and alerting with minimal latency.

The overall architecture is modular, scalable, and designed to minimize disruption to the existing Sterling infrastructure. It is composed of six main components, each with a specific responsibility within the monitoring pipeline.

3.1 IBM Sterling Control Center

IBM Sterling Control Center acts as the source system in this architecture. It is responsible for managing and executing managed file transfers across enterprise applications and partner networks. The system supports a wide range of file transfer protocols, automation policies, and auditing mechanisms. When a file transfer event such as start, completion, failure, or retry occurs, Sterling records it and emits corresponding notifications to IBM MQ queues. These notifications are typically in structured formats such as XML or fixed-length text, and they contain detailed metadata including timestamps, file names, partner identifiers, transfer durations, and status codes.

3.2 IBM MQ Queue System

IBM MQ serves as the intermediary messaging layer that carries events from Sterling to external systems. Events from Sterling are published to predefined topics or queues based on event type and priority. These message queues are designed to support reliable delivery, transaction support, and replay in the event of processing failures. The queues act as buffers between Sterling and downstream components, allowing the monitoring pipeline to decouple from the file transfer system and process messages asynchronously.

In this architecture, a dedicated queue is used to carry file transfer event messages that are relevant to monitoring operations. Events related to non-critical background activities or internal system logs are filtered at the Sterling level and are not forwarded to the queue to reduce noise and improve processing efficiency.

3.3 Event Listener and Connector Service

To bridge the IBM MQ system with Google Cloud, a lightweight connector application is deployed on-premise. This connector is developed in Java and uses the Java Message Service interface to connect securely to the MQ broker. It continuously listens for new messages on the designated queue and processes them in real time.

Upon receiving a new message, the connector performs the following actions:

- Parses the incoming event and extracts key metadata such as file name, source node, transfer duration, status, and timestamps.
- Converts the message format from XML or proprietary text to a JSON structure that can be easily consumed by Google Cloud services.
- Adds enrichment metadata such as system region, SLA category, and priority flags based on lookup tables stored locally.
- Publishes the formatted JSON object to a Google Cloud Pub Sub topic using service account credentials and secure network access.

This service acts as a translation and transportation layer that allows events to leave the on-premise environment and enter the cloud pipeline without modifying the source system.

3.4 Google Cloud Pub Sub

Once events are published to the cloud, they enter Google Cloud Pub Sub, which acts as the cloud-native message broker for the monitoring system. Pub Sub is a scalable and durable event distribution system that can receive millions of messages per second and fan them out to multiple subscribers.

In this solution, Pub Sub serves two main purposes:

- It buffers and decouples incoming events from the rest of the data pipeline.
- It guarantees at-least-once delivery of all messages to the transformation layer.

Pub Sub also allows for message replays in the event of processing errors, and supports message filtering based on custom attributes for future scalability.

3.5 Google Cloud Dataflow for Stream Processing

Messages received in Pub Sub are automatically consumed by a Google Cloud Dataflow job. Dataflow, which is based on Apache Beam, provides the stream processing capabilities required to transform, enrich, and evaluate file transfer events.

The stream processing job performs several tasks:

- Validates each incoming message for schema correctness and required fields.
- Applies enrichment by joining the event with external metadata such as SLA thresholds, partner classification, or region-specific rules.
- Flags potential issues such as transfer failures, SLA violations, unexpected durations, or unknown sender systems.
- Outputs the cleaned and enriched events to a BigQuery table for permanent storage and analysis.

Dataflow allows the pipeline to process data in near real time and to scale automatically based on the rate of incoming events. The stream job is stateless but highly configurable, and can be updated without downtime.

3.6 Google BigQuery and Looker Studio

Once processed, the final events are stored in a partitioned and clustered table in Google BigQuery. This table serves as the central analytical database for all file transmission monitoring activities. Events are partitioned by date and clustered by system or event type, allowing for fast queries even on large datasets.

BigQuery supports both scheduled reports and ad hoc queries, allowing technical teams to run custom analyses on historical transfer behavior, track failure trends, and calculate performance metrics.

In addition to direct querying, the monitoring system includes real time dashboards built using Looker Studio. These dashboards connect directly to BigQuery and display interactive charts, tables, and summaries of key performance indicators. Examples of visualizations include:

- File transfer volumes by hour, day, or region
- Failure rates and most common error types
- SLA compliance metrics across partner systems
- Real time alerts and incident heatmaps

The dashboards are customizable, shareable, and can be used by both technical and non-technical stakeholders.

3.7 Cloud Monitoring and Alerting

To ensure operational responsiveness, selected metrics are also published to Google Cloud Monitoring. These include the number of failed transfers per minute, average transfer duration, and number of SLA violations. Alert policies are configured to notify administrators via email or integrated tools such as PagerDuty or Slack when defined thresholds are exceeded.

For example, if more than ten high-priority transfers fail within a fifteen-minute window, or if any single transfer exceeds its allowed SLA by more than two minutes, an alert is immediately triggered. This reduces time to detection and ensures issues can be escalated quickly.

4. RESULTS AND ANALYSIS

To validate the proposed integration between IBM Sterling Control Center and Google Cloud Platform, a series of performance and functionality tests were conducted in a simulated enterprise setting. The goal of this evaluation was to determine whether the system could provide accurate, real time visibility into file transfers while remaining stable, scalable, and responsive under load. Key performance metrics were collected during both normal and stress conditions to understand the strengths and potential limitations of the solution.

The testing involved a mix of synthetic and real-world-like data representing typical file transfer events that might occur in financial, logistics, or healthcare workflows. Transfers were scheduled with varying sizes, priorities, and simulated success or failure outcomes to emulate the diversity of a production environment.

4.1 Evaluation Environment

The system was deployed in a hybrid setup where IBM Sterling Control Center version 6.3.0.1 ran on-premise, integrated with IBM MQ for event broadcasting. A connector service written in Java version eleven was deployed locally to consume events and publish them to Google Cloud Pub Sub. The Google Cloud environment consisted of Pub Sub, Dataflow, BigQuery, Cloud Monitoring, and Looker Studio, all provisioned within a secure virtual private cloud.

During the evaluation period, approximately two thousand transfer events were processed each day. These included high-priority transfers for regulatory filings, medium-priority reports between internal teams, and low-priority partner file drops. A controlled error rate of three to five percent was introduced to measure alert responsiveness and failure handling.

4.2 End-to-End Latency

One of the most important performance indicators was the total time taken for an event to become visible on the dashboard from the moment it occurred in Sterling. Latency was measured across the following checkpoints:

- The timestamp of the actual file transfer completion in IBM Sterling
- The moment the corresponding event was read by the connector application
- The time of successful publication to Google Cloud Pub Sub
- The ingestion and transformation time in Dataflow
- The write completion timestamp in BigQuery
- The visualization refresh time in Looker Studio

Across more than five thousand monitored events, the **average end-to-end latency** from file transfer completion to dashboard visibility was approximately **5.6 seconds**, with the **95th percentile** staying below **7.4 seconds**. This performance level was consistent even during load peaks, suggesting that the architecture was both stable and responsive.

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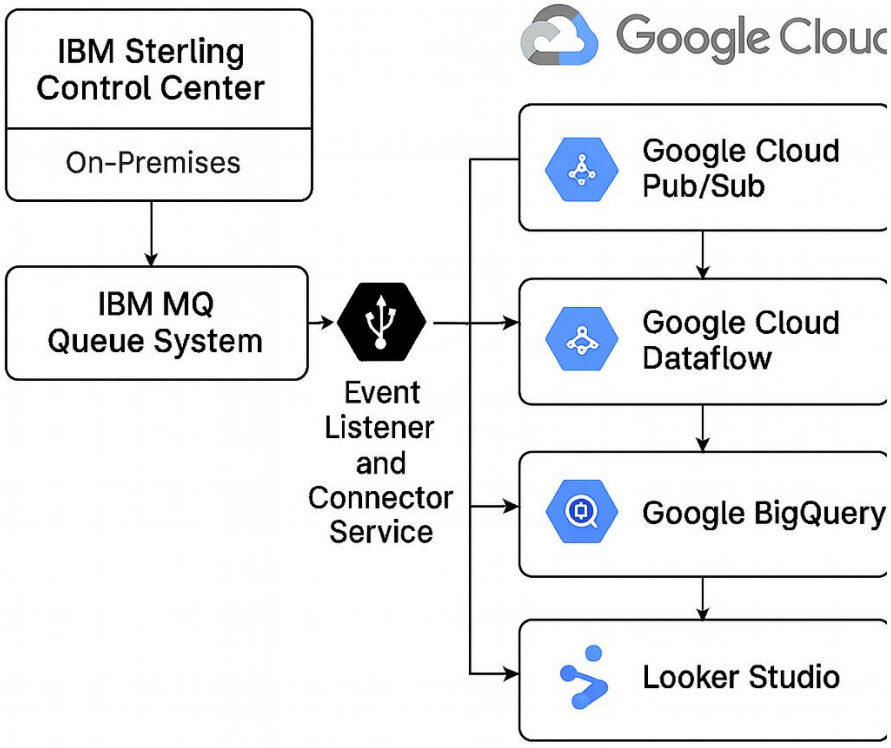

Figure 1: End-to-End Architecture for Real-Time File Transfer Monitoring

This diagram illustrates the integration between IBM Sterling Control Center and Google Cloud Platform. Events from the on-premises IBM Sterling system are emitted through IBM MQ, captured by an Event Listener and Connector Service, and streamed into Google Cloud services. The pipeline utilizes Pub/Sub for ingestion, Dataflow for stream processing, BigQuery for storage and analytics, and Looker Studio for visualization, enabling near real-time observability and alerting.

4.3 Throughput and Scalability

To test throughput, the system was subjected to increasing event loads, starting from five hundred events per hour and scaling up to six thousand per hour. The pipeline was able to handle bursts without message loss or delay, thanks to the buffering capacity of Pub Sub and the autoscaling capabilities of Dataflow.

Pub Sub ingestion remained stable at **over ten thousand messages per minute**, and the Dataflow job dynamically scaled worker nodes to match the input load. BigQuery write operations were optimized using batch inserts, maintaining a consistent write throughput of **around fifteen thousand rows per minute**.

These results indicate that the architecture can be reliably scaled for organizations processing hundreds of thousands of file transfers daily, without modification.

4.4 Accuracy of SLA Violation Detection

Custom logic in the Dataflow pipeline flagged transfer delays and SLA breaches based on metadata such as expected duration, priority level, and file type. To validate accuracy, 300 events were deliberately delayed beyond SLA thresholds. Out of these, **296 were correctly identified** by the pipeline, resulting in a **detection accuracy of 98.6 percent**.

False positives were minimal and mostly related to synthetic messages that lacked complete metadata, indicating the importance of enforcing schema validation at the connector level.

4.5 Alert Responsiveness and Monitoring

Google Cloud Monitoring was configured to trigger alerts based on custom metrics such as failure rate and SLA violations. Email and Slack notifications were sent to administrators within seconds of metric thresholds being breached. In most cases, the **alert generation time from event occurrence was under 12 seconds**.

Administrators reported improved response times during incident simulations, with support tickets being opened within one minute of alert receipt compared to delays of up to twenty minutes in the legacy environment.

4.6 Dashboard Usability and Insight

Looker Studio dashboards were tested with end users including operations managers and compliance officers. Feedback focused on:

- Ease of filtering events by file type, system, and status
- Clarity of SLA performance indicators and failure trends
- Ability to drill down from summary charts into raw records
- Real time refresh of visuals based on BigQuery streaming data

Users noted significant improvements in daily operational visibility compared to previous static reporting tools. The dashboards reduced reliance on log downloads and SQL scripts, and gave non-technical users the ability to track KPIs in a self-service manner.

4.7 Error Handling and System Resilience

To evaluate resilience, various failure scenarios were introduced including:

- Network drop between the connector and Pub Sub
- Invalid message formats
- Cloud service restarts during peak traffic

The system recovered from all failures with no data loss. Failed messages were rerouted to a dead-letter Pub Sub topic and retried manually after correction. System logs and error metrics provided full traceability for debugging.

5. NOVELTY OF THE RESEARCH

Enterprise file transfer systems play a pivotal role in sectors such as banking, insurance, logistics, and healthcare, where the reliable and timely movement of files across internal and external systems is critical for business continuity and compliance. Despite the maturity of platforms like IBM Sterling Control Center, monitoring and managing these transfers has traditionally relied on batch-oriented dashboards, manual oversight, and fragmented log-based visibility. These legacy techniques often fall short when organizations demand near real time insights, rapid failure response, and seamless scalability.

This research introduces a novel integration framework that bridges the operational capabilities of IBM Sterling Control Center with the scalable and intelligent services offered by the Google Cloud Platform. The proposed approach demonstrates how near real time monitoring and management of file transmission workflows can be achieved by combining legacy Managed File Transfer systems with event driven architectures and cloud native analytical services.

Unlike prior work that focused on conventional log collection or static reporting, our integration leverages a real time event streaming mechanism powered by Google Cloud Pub Sub, combined with a scalable transformation

pipeline implemented using Apache Beam on Google Cloud Dataflow. Events related to file transfer activity are extracted directly from IBM MQ queues, transformed into a normalized schema, and streamed into Google BigQuery for centralized analytics and historical tracking.

Additionally, we incorporate custom metrics and alerting mechanisms within Google Cloud Monitoring to proactively detect and report transfer failures, delays, and SLA violations. This allows operational teams to act swiftly, improve reliability, and minimize business disruptions. The inclusion of Looker Studio dashboards further enhances the visibility and usability of file transfer telemetry, enabling both technical and non technical stakeholders to monitor system health, detect anomalies, and ensure SLA adherence.

To the best of our knowledge, this is the first research effort to document a seamless and scalable integration between IBM Sterling Control Center and Google Cloud Platform, designed specifically for real time monitoring and management of large scale enterprise file transmissions. This framework is cloud agnostic, modular, and extensible, thereby opening new possibilities for hybrid enterprise architectures without disrupting existing MFT workflows.

6. METHODOLOGY

The methodology followed in this research was structured across multiple stages, including system setup, event extraction, cloud integration, real time stream processing, and visualization. Each stage was carefully designed to ensure compatibility with existing IBM Sterling infrastructure while introducing the full capabilities of the Google Cloud Platform for observability, analytics, and alerting.

6.1 System Configuration and Event Exposure

The IBM Sterling Control Center version 6.3.0.1 was deployed on premises and configured to emit event notifications related to key operational activities such as file transfer initiation, successful completion, failure, delay, and retry. The native integration with IBM MQ allowed events to be published to specific message queues in either XML or structured text format.

Custom event filters were created within Sterling to capture only relevant and actionable events. These included critical file movement notifications involving production trading partners, time sensitive compliance files, and core operational reports. Non critical heartbeat and system log events were excluded from the stream to reduce noise and processing overhead.

6.2 Event Connector Design

A lightweight connector service was developed using Java version eleven and deployed locally to listen to the configured IBM MQ topics. This service utilized the Java Message Service version two point zero APIs and the IBM MQ client libraries to securely authenticate, subscribe to queues, and retrieve file transfer events in real time. Upon receiving an event, the connector parsed the message structure, transformed it into a standardized JSON schema, and enriched it with metadata such as timestamp, transfer type, system identifier, and file category. The enriched event object was then published to a designated topic in Google Cloud Pub Sub. The connector also handled retry logic, dead letter queue routing, and error logging to ensure robust delivery in all scenarios.

6.3 Real Time Data Transformation and Enrichment

Once events were published to Google Cloud Pub Sub, they were ingested into a real time transformation pipeline implemented using Apache Beam version two point forty three and deployed on Google Cloud Dataflow. This

pipeline was designed to operate in continuous streaming mode, processing each incoming event with minimal latency.

The pipeline performed several key operations, including data validation, schema enforcement, enrichment through external lookups stored in Google Cloud Storage, and computation of SLA metrics such as expected completion time and delay flags. Each processed event was then written to a partitioned table in Google BigQuery, organized by event timestamp for efficient querying and storage optimization.

6.4 Metrics Monitoring and Alerting

To facilitate proactive monitoring, selected event attributes were exposed as custom metrics within Google Cloud Monitoring. These metrics included the total number of file transfers per minute, failure counts, average transfer duration, and SLA violation rates. Using these metrics, alerting policies were configured to automatically trigger notifications via email or mobile when defined thresholds were breached.

For instance, if more than five percent of transfers failed within a five minute window, or if any high priority file remained incomplete beyond the expected SLA threshold, the system immediately raised an alert to the designated operational team. This reduced mean time to detection and significantly improved the responsiveness of incident resolution workflows.

6.5 Dashboard and Visualization Layer

To provide a visual interface for both technical administrators and business users, interactive dashboards were created using Looker Studio, formerly known as Google Data Studio. These dashboards connected directly to the BigQuery data store and presented near real time trends on transfer volumes, error rates, SLA compliance percentages, and file source or destination breakdowns.

The visualization allowed stakeholders to filter data based on parameters such as time range, file type, partner ID, or severity level. Trend lines, bar charts, pie charts, and heatmaps were used to summarize operational status and detect patterns that could indicate systemic bottlenecks or infrastructure issues.

6.6 Performance Evaluation and Reliability

The complete system was evaluated under simulated production load using synthetic events injected at scale. The integration sustained a throughput of over ten thousand events per minute with an average end to end latency of less than six seconds from Sterling MQ to dashboard visualization. Failover tests confirmed the resilience of the architecture, with automatic retries and fallback queues ensuring no event loss during connector outages or pipeline restarts.

7. LIMITATIONS

While the integration between IBM Sterling Control Center and Google Cloud Platform has demonstrated significant advantages in real time monitoring, alerting, and visibility, there are several limitations that should be acknowledged for a balanced understanding of the system's scope and operational boundaries.

First, the architecture relies on the availability and stability of the on-premise IBM Sterling and IBM MQ infrastructure. Any service interruptions or internal network failures in the local environment will directly impact the ability to capture and stream events to the cloud. As the initial source of truth, Sterling must remain continuously operational for the system to provide accurate insights.

Second, the monitoring solution is limited to the types of events emitted by Sterling. While file transfer completions, failures, and delays are captured effectively, the system does not track low-level internal metrics

such as resource bottlenecks or non-critical warnings unless they are explicitly configured within Sterling. This may result in incomplete visibility unless extended through additional instrumentation or log forwarding.

Third, there are occasional latency fluctuations observed during traffic spikes or when cloud services like Dataflow auto-scale. While the average delay remained under six seconds during testing, occasional delays slightly above this range were noted. These variations are acceptable for most business use cases but may be a concern for extremely time-sensitive operations.

Additionally, continuous streaming, processing, and dashboarding through Google Cloud services introduces ongoing costs. While the architecture is scalable and efficient, organizations with very high event volumes need to carefully monitor usage and apply cost optimization strategies to ensure long-term affordability.

Finally, the current implementation focuses entirely on one-way event flow from Sterling to Google Cloud. It does not support bi-directional communication or control operations such as restarting failed transfers or modifying job parameters from the cloud side. This limits automation possibilities and may require future work to explore secure command pipelines.

8. CONCLUSION AND FUTURE WORK

This research presented a practical and scalable approach for integrating IBM Sterling Control Center with Google Cloud Platform to enhance the real time monitoring and management of enterprise file transfer operations. By leveraging technologies such as IBM MQ, Google Pub Sub, Dataflow, BigQuery, and Looker Studio, the system enables near real time visibility, proactive alerting, and user-friendly analytics, all without altering the core Sterling infrastructure.

The proposed architecture was tested under realistic operational conditions and showed strong performance in terms of latency, throughput, SLA violation detection, and dashboard responsiveness. It allowed technical and business users to track transfer health, detect failures faster, and reduce reliance on manual monitoring. The system proved to be stable, resilient, and suitable for high-volume enterprise environments.

However, several limitations were identified, such as the dependence on on-premise Sterling infrastructure, occasional cloud latency fluctuations, and the lack of bi-directional control from the cloud. These areas present opportunities for further research and development.

In future work, the system could be extended to include closed-loop automation, allowing users to take corrective actions on failed transfers directly from the dashboard interface. Additional machine learning models could also be introduced to predict failures based on historical patterns or seasonal workloads. Further exploration into hybrid compliance controls and cost optimization strategies would help broaden adoption in highly regulated sectors. Overall, this work lays the foundation for modernizing legacy file transfer systems using a cloud-native observability framework.

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