Channeling Streaming Data for Competitive Advantage

How SAS® Event Stream Processing Is Driving Innovation and Solving Complex Challenges
Contents

Streaming Data: Driving the Next Wave of Industry Transformation ......................................................... 1

Analytics Unlocks the Value of Streaming Data ................................................................. 2

SAS: Leading the Wave ........................................................................................................... 2

How Are Companies Harnessing Streaming Data Today? ............................................. 3

Marketing ................................................................................................................................. 3

Increasing Personalized Campaign Effectiveness .......................................................... 3

Fraud Detection ......................................................................................................................... 4

Intercepting Online Fraud ............................................................................................................... 4

Market Risk Reporting ............................................................................................................... 6

Reducing Exposure to Financial and Reputational Risk ..................................................... 6

Retail Optimization ..................................................................................................................... 6

Competing Through Enhanced, In-Store Customer Experiences ......................................... 6

Health and Life Sciences .......................................................................................................... 8

Patient Risk Detection and Alerts ............................................................................................ 8

Predictive Asset Maintenance ..................................................................................................... 8

Detecting Asset Defects Early ..................................................................................................... 8

Network Optimization ............................................................................................................... 9

Improve Service Levels ............................................................................................................. 9

Key Takeaways ........................................................................................................................... 10
Streaming Data: Driving the Next Wave of Industry Transformation

Today, data is constantly flowing in and out of organizations from electrical and mechanical sensors, RFID tags, smart meters, scanners, mobile devices, vehicles, live social media, machines and other objects. Did you know that a modern plane with more than 10,000 sensors just in the wings is expected to generate more than 7 terabytes a day? And Bain predicts that by 2020 annual revenues could exceed $470 billion for the internet of things (IoT) vendors selling hardware, software and comprehensive solutions.\(^1\)

Analysts believe that all of this data will drive a new type of industrial revolution – one that’s driven by highly accurate, real-time analysis, alerts and actions. Increasingly, machines will automate decisions and simply notify humans with instructions. Consider the promise of the IoT, where any object can be connected to the internet and continuously send and receive data. Gartner says that by 2020, 21 billion IoT devices will be in use worldwide.\(^3\)

As more devices, machines and industrial assets connect and communicate real-time data, ecosystems connecting businesses will harness this data to radically change the way they function and act. Streaming analytics (see sidebar) can extract the meaning from this data in an instant, as it is created, and automate reactions with millisecond response times. This can mean the difference between remaining competitive or falling behind – and it opens the door to revolutionary business models that can revitalize productivity and success.

The value of insights from streaming data goes beyond IoT case studies; it extends to all aspects of a business. For example, imagine the value of being able to instantly analyze streaming data if your organization is focused on:

- **Cybersecurity.** Analyze streaming data to identify a malicious intrusion as it occurs (or even before it does) and stop it before damage is done.
- **Fraud.** Stop paying the wrong people, and prioritize cases by analyzing streaming transactions to know what needs the most immediate attention.
- **Predictive maintenance.** Analyze data streaming from production machinery and sensors to predict outlier conditions and potential asset failures, and fix underlying problems before issues arise.
- **Customer experience and marketing.** Use streaming data insights to personalize online offers as customers contemplate a purchase, and make ads relevant while they are physically shopping in stores or over the web.
- **Stream data management.** Store only the data you need by accessing, transforming and cleansing data while it’s still in motion – delineating what to store and what to ignore.

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1. datasciencecentral.com/profiles/blogs/that-s-data-science-airbus-puts-10-000-sensors-in-every-single

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**Streaming Analytics in a Nutshell**

In traditional analysis, data is stored and then analyzed. But with streaming data, it’s the models and algorithms that are stored, and incoming data is analyzed as it passes through them. All this happens as the data is being generated or transmitted in real time. So before streaming data is stored in the cloud or in any high-performance repository, it’s processed automatically, with the analytics deciphering both its meaning and value. All the while, new data keeps streaming in.

Bain predicts that by 2020 annual revenues could exceed $470 billion for the IoT.\(^4\)
Analytics Unlocks the Value of Streaming Data

The focus of this paper isn’t the data you store in a data warehouse and keep around for later analysis. It’s about data that’s flowing into your organization in real time, which can be analyzed before it’s stored. It’s about being able to generate instant alerts, pinpoint event relevance and urgency for action, and identify meaningful signals from the abundance of streaming data.

What organizations are discovering is that they need a new approach to keep up with the demand for faster insights on data.

The way to get there is with **event stream analytics software** that can process millions of events per second (before they’re persisted in a data store). Data transformations and analytics used inside event streams help organizations accurately and quickly detect patterns and anomalies in multiple sets of big data. So you can understand what’s about to happen, make immediate adjustments, generate notifications, prevent failures, minimize security risks and grasp opportunities before an event or opportunity is over. Streaming analytics can even help you decide what data and events are important to take action on, what can be ignored, and what should be stored, as well as bring streaming event insights to traditional business applications.

**SAS: Leading the Wave**

SAS is leading the streaming analytics market with SAS Event Stream Processing – a technology that continuously assesses streaming data as it’s being generated, and transforms and uses it to define relevant actions in real time. The result is streaming data insights that ensure people, machines and processes know what actions to take, what alerts to issue, what to stop, and what portions of data need to be investigated more deeply using other analytical software. And because SAS Event Stream Processing integrates with other operational software, these insights can be connected to the correct action to ensure that things don’t slip by.

SAS Event Stream Processing uses continuous queries to scrutinize live data and detect patterns of interest. No stream of data is too big or too fast. It’s designed for exceptional processing speeds, bounded only by the limitations of your hardware environment. Computations are distributed in memory, in stream and in real time (submilliseconds and even submicroseconds).

The solution also integrates with business operations software and other SAS solutions, so streaming data is directly incorporated into core business processes, analytical assessments, case management activities and workflows. In doing so, it brings the immediate value of streaming analytics to a host of applications used in customer experience, asset performance, fraud, compliance, security, risk and other contexts.
<table>
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<tr>
<th>Unique capability</th>
<th>Description</th>
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<tbody>
<tr>
<td>Quickly consume and connect streaming data</td>
<td>Using a suite of prebuilt adapters and connectors, SAS Event Stream Processing ingests both structured and unstructured text data – directly writing analyzed results to other systems and applications, including SAS analytics solutions. Once data is sourced, you can manipulate live data streams to quickly detect, filter, aggregate, correlate and delineate patterns of interest. Organizations benefit from the exceptional low latency response that helps them excel beyond the competition.</td>
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<tr>
<td>Adapt in-stream analytics and data manipulation</td>
<td>SAS Event Stream Processing supports highly modular, continuous queries built using advanced analytics algorithms, transforms and rules. You can apply the power of SAS to pinpoint relevant events using continuous pattern detection models, using a drag-and-drop interface to minimize manual coding.</td>
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<tr>
<td>Build streaming analytics into business operations</td>
<td>Gain a competitive advantage with high-speed responsiveness and event stream intelligence in all areas of operations that demand immediate actions – from workflow and system integration to situational reporting. All of this is made possible with a system that includes native failover, unified management and security, and IT-related capabilities from a single administrative interface.</td>
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Table 1: Highlights of the unique capabilities of SAS Event Stream Processing.

How Are Companies Harnessing Streaming Data Today?

The best way to understand the unique value and potential of SAS Event Stream Processing for your business is to see how other companies are benefiting from it. The following case studies are based on actual customer solutions. They illustrate how organizations are using streaming data – and stepping into a whole new realm of competitive advantage.

Marketing

Increasing Personalized Campaign Effectiveness

When one of the world's largest telecommunications companies faced rising competition, management decided to dramatically increase revenues from its existing customer base. To do this, it needed a new way to personalize cross-selling and up-selling offers while customers were using their cellphones – by analyzing live activity data. The company defined these active customer usage campaigns (such as recharging prepaid plans on the fly) as "special events" that get triggered, personalized and pushed to customers based on their current cellphone use.

But to determine experience-based, personalized offers in real time during active phone use, customer data had to be captured and analyzed during customer calls. To achieve this, the company chose SAS Event Stream Processing, along with the SAS Decision Management technology specifically designed for personalized campaign execution (SAS Real-Time Decision Manager). Live cellphone usage data is captured as event streams and analyzed while a call is in progress to identify patterns of use. These patterns are then used to generate individualized offers. The direct integration of SAS Event Stream Processing with SAS Real-Time Decision Manager makes it easy to bring insights from call data streams into the campaign business solution, which then acts on the streaming analytics instructions in real time to ensure high offer relevance. Accordingly, higher relevance resulted in a tenfold increase in offer acceptance.
Figure 1. This conceptual view of the SAS architecture for a marketing personalization solution shows the flow of data across SAS solutions.

Armed with targeted and customized offer communications, this telecommunications service provider has been able to generate significant increases in revenues from its customer base, realizing a return on investment in only two months.

Figure 1 shows a conceptual view of the corresponding SAS architecture at work. Note the flow of data from various source systems to SAS Event Stream Processing, where data transformation, business rules and events of interest are identified to define a specific customer scenario. Next, relevant offers are created using SAS Real-Time Decision Manager.

**Fraud Detection**

**Intercepting Online Fraud**

When a leading bank began experiencing accelerated attacks from fraudsters and voice-phishing schemes in its online channels, IT put a stopgap in place. But this generated a huge false-positive ratio that wasted valuable investigative time and resources. In addition, the fraud team couldn’t use the stopgap to detect and prevent fraud in real time.

To protect against attacks and financial losses, the bank decided to give its fraud investigation team the ability to evaluate and block fraudulent transactions before they were completed. To make this happen, the company chose SAS Event Stream Processing with the SAS Fraud Framework.

Once the solution was deployed, the bank processed payments in real time and detected suspicious transactions in a fraction of a second. Using a suite of prebuilt adaptors, it integrated SAS Event Stream Processing with a variety of data sources that contain historic customer transaction information, profiles and even technical
information coming from the internet sessions of customers. Streaming transaction data is correlated in real time with known customer profiles.

When a suspicious transaction is detected, the transaction is now flagged and put on hold, alerting an investigator. Due to seamless integration with the SAS Fraud Framework, prioritized cases that need to be investigated are sent to SAS Enterprise Case Management for a quick, manual investigation. Pending the investigator results, the transaction is completed or stopped, and the profile is updated and actions taken are stored in traditional repositories. Investigative analysts can access this saved data, explore it dynamically, and look for and create new business rules graphically using SAS Visual Scenario Designer. They can also push new patterns of interest into SAS Event Stream Processing to create new, comparative baselines for customers.

As a result, information gathered from streaming data is incorporated back into real-time detection efforts. The solution continually adapts new scenarios to handle the ever-changing dynamics of fraudulent activity. SAS Event Stream Processing uses SAS’ industry-leading analytics for ongoing and comprehensive assessments of data in motion, even as changes in streaming data patterns occur. In addition, fraud investigators can better focus their resources on the true cases of fraud, not false positives.

Over time, the bank expects to spend less effort on recovery, receive fewer complaints from customers, and intercept about 95 percent of fraud attempts. More effective fraud prevention will help the bank maintain its clients’ trust.

Figure 2 is a conceptual view of its architecture, illustrating the flow of data from various transactional systems into SAS Event Stream Processing, which continuously monitors for patterns of interest and generates alerts for investigation.

![Figure 2. SAS Event Stream Processing analyzes data streams, identifies likely suspects and generates alerts.](image-url)
Market Risk Reporting

Reducing Exposure to Financial and Reputational Risk

An international banking and financial services company needed to drastically improve its market risk reporting and reduce its exposure to financial and reputational risk. This would require dramatically reducing the time needed to generate reports on the status of the organization – from an overnight, daily reporting cycle to simplified, intraday reporting. The bank’s existing reporting architecture simply couldn’t support this level of service for the entire portfolio.

To realize its goal, the bank deployed both SAS Event Stream Processing and SAS High-Performance Risk. Transaction and operational data from different channels is streamed into the SAS Event Stream Processing engine. As it streams, data is cleansed and manipulated, and business rules are applied. This initial data processing is done inside the live transaction streams before the data is stored and made available for deeper investigation and reporting using SAS High-Performance Risk. The approach has reduced data management complexity and decreased data errors.

For the bank, streaming transactions are now immediately understood and connected to the correct action. SAS Event Stream Processing detects when transaction detail is sufficient to execute specific, elementary calculations captured as windows of live events in the stream. And once these calculations are computed, they trigger the execution of redefined tasks in the risk reporting system.

This solution has given the bank quicker access to 10 times the volume of data on a given day. Analysts at the company can analyze data sets of up to 7 terabytes of granular risk data – all on demand. Figure 3 illustrates how the data flows throughout the solution and the bank’s existing business systems.

Retail Optimization

Competing Through Enhanced, In-Store Customer Experiences

A major retailer wanted to improve the experience of in-store shoppers, as well as dissuade them from abandoning carts in favor of purchases with a competitor. The retailer had ready launched a mobile app for coupons that were targeted to consumption profiles. Now it wanted to use integrated software to improve:

- **In-store price checking behavior** to deter customers who are comparing prices using their mobile device from abandoning a similar purchase while in a store.
- **In-store shopping frequency** by motivating shoppers to come visit local stores and make purchases.
- **Product return experiences** by turning return purchase events into cross-sell and up-sell opportunities that turn dissatisfied customers into satisfied customers.
- **Social media trend detection** so it can understand when products are trending on social media and demand will increase.
To achieve these goals, the retailer used SAS Event Stream Processing together with SAS Customer Intelligence and SAS Real-Time Decision Manager. These products support a variety of enhanced, in-store customer experiences that help the retailer compete more effectively while boosting customer satisfaction and retention. For example, SAS Event Stream Processing monitors in-store WiFi clickstreams to detect when a customer accesses a price comparison site; retrieves the IP address, device ID and phone number; uses this information to look up existing customer profiles; and determines if the customer is a candidate for a promotion. If so, SAS Real-Time Decision Manager identifies the best offer and sends it to the customer within seconds.

To promote in-store shopping, the retailer sends customers personalized, optimized email promotions with sales and offers based on each customer’s shopping history and local store quantities. SAS Event Stream Processing monitors in-store routers and detects when customers (and their mobile devices) enter the store – then it looks up customer details and histories. SAS Real-Time Decision Manager will execute decisions based on a customer’s history and interface with SAS Marketing Optimization to retrieve an optimal set of offers to push to the in-store customer via SMS or email.

Similarly, when customers come to stores to return an item, details will be retrieved from scanned receipts instantly by SAS Event Stream Processing. SAS Real-Time Decision Manager can analyze the customer’s history, recommend a specific sales staff interaction, and generate and send coupon codes to the customer’s mobile device for alternative replacements currently in stock. In addition, other promotions that the customer may find interesting are sent.

Using SAS, the retailer expects higher store sales, longer customer store visits and higher customer satisfaction ratings.
Health and Life Sciences

Patient Risk Detection and Alerts

A major US health care provider sought ways to optimize patient outcomes while lowering the cost of care by immediately detecting threats to the lives of patients and reacting in near-real time. To achieve these goals, the organization needed to monitor streaming patient data from labs and multiple devices used to monitor patients’ vital statistics, detect relevant patterns in real time, and trigger timely actions. These actions included:

- Sending messages across SMS and email systems.
- Alerting critical care teams.
- Sending immediate recommendations to remote patients to help them head off problems.

SAS Event Stream Processing is used to capture and analyze streaming patient data in real time. The software combines sensor data with incoming lab results to detect concerning data patterns and trigger alerts to appropriate critical care teams. Care providers can quickly understand the current health state of their patients and instantly assess the risks that may lead to possible patient deterioration. As a result, care providers – and the organization overall – can:

- Solve more event-driven patient care problems that they couldn’t detect and address quickly enough before.
- Conduct rapid root-cause analysis for longer-term solutions.
- Deploy accurate predictive models for efficient risk prevention.
- Realize better patient outcomes.

Predictive Asset Maintenance

Detecting Asset Defects Early

Predictive maintenance technologies can play a vital role in helping manufacturers achieve higher asset utilization and reliability - and ultimately greater competitiveness. For example, SAS Event Stream Processing is being used by a wide range of asset-intensive industries to detect problems and weaknesses before assets or parts fail or irreparable, costly damage occurs.

For example, one company is using SAS Asset Performance Analytics to detect wheel problems on large transport vehicles as a way to head off costly problems that can affect services and revenue. As wheels age, they become damaged – and can even damage the thoroughfare on which they travel. Wheel defects can cause excessive impact loads, so when they go unnoticed they pose a greater risk of damage and accidents, and they generate greater friction that leads to overheating and even trackside fires. Traditional hotbox detectors identified problems too late – after damage was done.

Predictive maintenance solutions based on SAS Event Stream Processing are helping to predict impending failures and generate notifications in real time so issues can be addressed proactively to minimize and even prevent damage. As shown in Figure 4, the software ingests streaming force readings from a message queue that receives data from wheel impact load detector systems. It analyzes the data as it’s streaming to identify patterns and trends, scores the readings as they come in, and identifies and reacts to an impending failure as soon as possible. Analytical models – created in SAS® Enterprise Miner™ – are included in the continuous event stream queries, decision trees, neural nets and regression equations.
Figure 4. SAS Event Stream Processing predicts asset failures and problems by analyzing streaming data.

This same type of solution can be applied to just about any asset-intensive industry. For example, oil and gas producers need to minimize unplanned production interruptions caused by failures of electric submersible pumps. Using SAS Event Stream Processing, they can easily extend insights from SAS Predictive Asset Maintenance into a real-time monitoring environment. This allows them to:

- Minimize pump downtime by anticipating electrical and mechanical issues.
- Identify new patterns in data that can be further analyzed for performance impacts or root causes using SAS Predictive Asset Maintenance.
- Enable real-time asset performance reporting for a remote monitoring center.

Network Optimization

Improve Service Levels

An electric power company wanted to monitor its network in real time to proactively address issues that could affect service levels. Specifically, it needed real-time analytics to:

- Understand steady-state operations.
- Detect events on the network as they happen.
- Categorize events on the network.
- Direct appropriate actions based on the event.
- Capture data for post-event analysis.

Using SAS Event Stream Processing and other complementary SAS software such as SAS Forecasting, it applies streaming-data analytical techniques to:

- Analyze frequency data from line-trip events to detect events occurring within engineering specifications.
- Forecast expected values and detect deviations in power signatures.
• Take incoming events and categorize them.
• Build a reference library of various event types.
• Predict events that are very rare but impactful.

Now the company can detect issues early – even before network failures occur – and help ensure high levels of uptime.

Key Takeaways

The case studies discussed in this paper demonstrate how SAS is helping organizations quickly derive business value from streaming data. In the future, organizations must be prepared with technology that allows them to handle vast amounts of data that’s streaming in from an ever-increasing number of sources. Consider that McKinsey estimates the total IoT market size in 2015 was up to $900 million, growing to $3.7 billion in 2020.5

Clearly, our world is increasingly automated. With IoT, computer technology is intertwined with manufacturing, transportation, energy, financial services, health care, travel, entertainment, automobiles, communications, housewares, personal devices and almost every aspect of modern human existence. At the same time, people are generating massive volumes of data online and through mobile devices. All of this is generating petabytes of data. The future belongs to organizations that can use analytics to transform that data into real-time value.

As Geoff Beynon explains in a Computerworld article, “In-stream analytics keeps pace with the speed of the IoT and detects patterns of relevance in midactivity. This enables instant programmed or manual reaction to address anomalies on the one hand or quickly exploit opportunities on the other.” 6

With SAS Event Stream Processing, you can understand, utilize and analyze streaming data in submilliseconds – much faster than human perception – so you can gain insights while data is in motion. With this knowledge, you can give the right instructions to trigger applications, system activity and human reactions, all from a single source.

Now is the time to take the leap and harness your streaming data to drive your business forward. To learn more, visit sas.com/en_us/software/data-management/event-stream-processing.html.

6 http://www.computerworld.co.nz/article/611156/powering-iot-in-stream-analytics