

How Real-Time Analytics Are Keeping Telenor's Customers Buzzing

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ABSTRACT

Customers around the world are increasingly demanding rapid and relevant responses from their vendors, meaning that delivering on these expectations has become a key competitive advantage. Telenor, a multinational telco headquartered in Norway, communicates with its 172 million customers in real-time, thanks to data and analytics.

Highly-efficient, real-time communications like these make great demands on platforms for data flow, maintenance, and real-time technology. Telenor uses the latest SAS technologies to develop solutions for handling consumer and business customer interactions.

This paper will discuss how SAS Real Time Decision Manager (RTDM) and SAS Event Stream Processing (ESP) complement each other and contribute to meeting the increasing demands of customers. We will present use cases to illustrate the motives and the operational setup of the customer dialog.

INTRODUCTION

This paper will give a brief description of how Telenor uses SAS Event Stream Processor and SAS Real Time Decision Manager together in order to tailor its communication with its customers.

This paper is written to give an overview of how SAS Real Time Decision Manager and SAS ESP can compliment each other. It will not dive deeply into the bits and bytes of data-caching, in-memory architecture or real time engines, but rather touch upon stateless versus stateful stream processing and why you should care. Little or no prior knowledge of SAS RTDM or SAS ESP is required.

The first main topic will introduce SAS Real Time Decision Manager, the second main topic will introduce SAS Event Stream Processor and the third and final main topic will highlight how they are used in conjunction at Telenor.

SAS REAL TIME DECISION MANAGER

In real-time marketing, part of the challenge is to act in real time, but it is considerably more challenging to carry out the right action at the right time.

Here are some common challenges that you might need to address:

- Identifying well suited responses or content in real time interaction. Some customers have a high churn probability, while others are related to an up-sale opportunity. The content and responses for these two customer groups should be different.
- Avoiding over-saturation of content: too many e-mails and text-messages (outbound channels) and a variety of different banners and recommendations in apps or on the web (inbound channels) may overwhelm the customer.

- Marketing budget: actions and responses may have a cost and may need to be controlled.

To address these challenges, you need a framework where analysis and customer insights are included in the marketing value chain. Different suggestions and possible responses need to be prioritized both from both a budgetary and customer-centric point of view. Content, responses and communication in different interaction channels need to be coordinated.

SAS Real Time Decision Manager addresses these challenges in real time, with a user interface, development and administration routines specifically tailored for real time marketing. Consider these three concepts of SAS Real Time Decision Manager:

- SAS RTDM subscribes to real time event streams, via web-services, to trigger real time targeted marketing campaigns.
- The events are enriched with additional data, such as customer history, analytical scoring or previous exposure to marketing campaigns. These enriched events will be subjected to decision rules.
- Through integration with a variety of channels, SAS RTDM implements a unified and tailored omnichannel marketing campaign for both outbound and inbound channels.

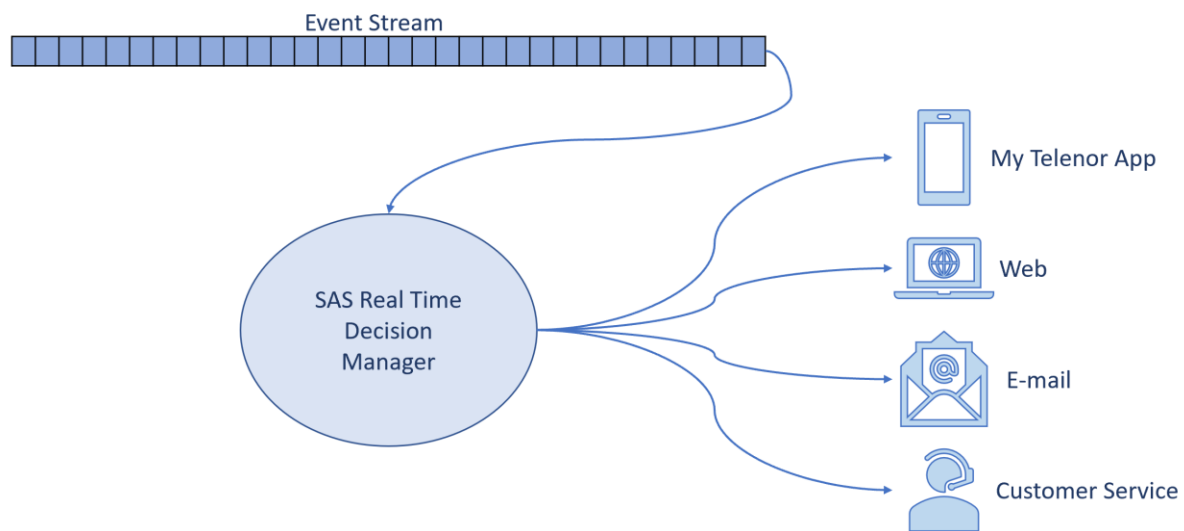


Figure 1. SAS Real Time Decision Manager subscribes to event streams and trigger-targeted omnichannel marketing campaigns in real time.

These three concepts make SAS RTDM a powerful marketing tool. You have a real time component enabling rapid response and interaction with complex underlying decision mechanisms. Enriched events mean that you can include analysis, e.g. Next Best Offer scoring, in the real time value chain, as well as prioritizing between different suggested campaigns.

Under the hood, SAS RTDM's Common Data Model works day and night to enable a holistic marketing strategy across different customers and different channels.

There is lot more that we could say about Real Time Decision Manager, but for this paper we will simply identify it as a tool capable of implementing and maintaining multiple and complex marketing campaigns in real time.

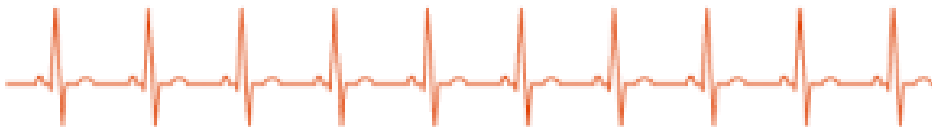
SAS EVENT STREAM PROCESSOR

SAS Event Stream Processor, like SAS Real Time Decision Manager, can react to events in real time. However, it transpires that SAS ESP and SAS RTDM do not render each other obsolete; on the contrary, used in conjunction, they actually complement each other, but to understand why, it is important to highlight the differences between reacting to a collection of single events, and reacting to event streams where events are viewed in relation to one another. In other word, the difference between stateless and stateful stream processing.

To highlight the differences between them, we temporarily leave the realm of Telco and Telenor, and dive into healthcare. Imagine that you are a healthcare professional overseeing the health of many patients. Efficiency is of the essence, and there are simply too many patients to adequately monitor the health of each one of them manually. To address the issue, key data about the patients are continuously monitored and events are produced. If the heart rate of a patient drops below or exceeds a certain threshold an event is produced, and an alert is raised. This means that health-care professionals can act accordingly and prevent an emergency.

Although SAS RTDM is primarily a marketing product, one could imagine that SAS RTDM could be used here. SAS RTDM can receive the event, enrich it with additional data, including age, gender and previous patient history, and use decision rules to categorize it as a high-, medium or low-risk case. Notifications about the events are distributed to relevant channels. It is easy to see that a high-risk event needs a more serious response than a low-risk event, and the former need to be prioritized. In this way, health-care professionals do not need to consider all the monitored data, but can be alerted and focus their attention where it is most needed.

Normal Heart Rhythm



Examples of Abnormal Heart Rhythms

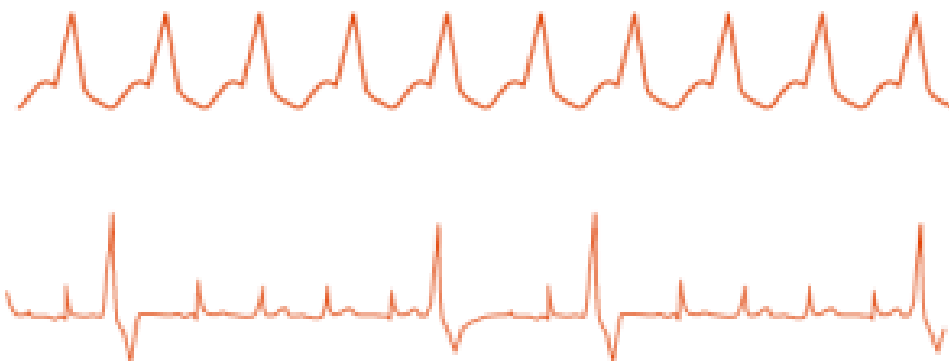


Figure 2. Examples of Heart Rhythms

This is a simplification, since an unhealthy heart-rate is seldom identified by its heart rate at a single point in time, but rather by identifying patterns in heart rates over time.

We immediately see the difference between a normal and abnormal heart rate, but it is important to note that this is enabled by the fact that we observe the heart rate over time. Each heartbeat is observed and interpreted in relation to previous heartbeats. If you observe the data as a continuous event stream, you must have a framework in which the new events are continuously seen in relation to previous observed events, and you must be able to identify complex patterns within the stream of events. It is not the heart-rate at a single point in time that is important, but rather the heart rhythm over a period of time. This is sometimes referred to as stateful stream processing. In the opposite case, when each event is processed individually, it is called stateless stream processing.

When someone refers to SAS Event Stream Processor as a complex stream engine capable of stateful processing in real time, this should open a few eyes. This means that SAS ESP is well suited for the task of differentiating between healthy and unhealthy heart rhythms in real time. To complicate this further, some abnormal heart rhythms are harmless, while other are indicative of an emergency, but SAS ESP is more than up to the task of differentiating between them.

Remember that SAS Real Time Decision Manager can trigger automatic campaigns based on web services, i.e. single events. This means that SAS RTDM will have difficulties responding adequately to the nuances of heart rhythms. Another thing to consider is that the throughput of data is very high when streaming heartbeats, and it is not smart to subject each heartbeat to the decision rules implemented in SAS RTDM.

By including SAS ESP in the real time value chain, you can successfully distinguish between healthy and unhealthy heart rhythms in real time. When SAS ESP has identified a pattern of interest, it generates a notification event, a single event saying, "I have found an abnormal heart rhythm". As SAS ESP continuously monitors the data stream, more notification events are created, effectively creating a notification event stream in real time. Normally the output notification stream event will be considerably smaller in terms of number of events per time.

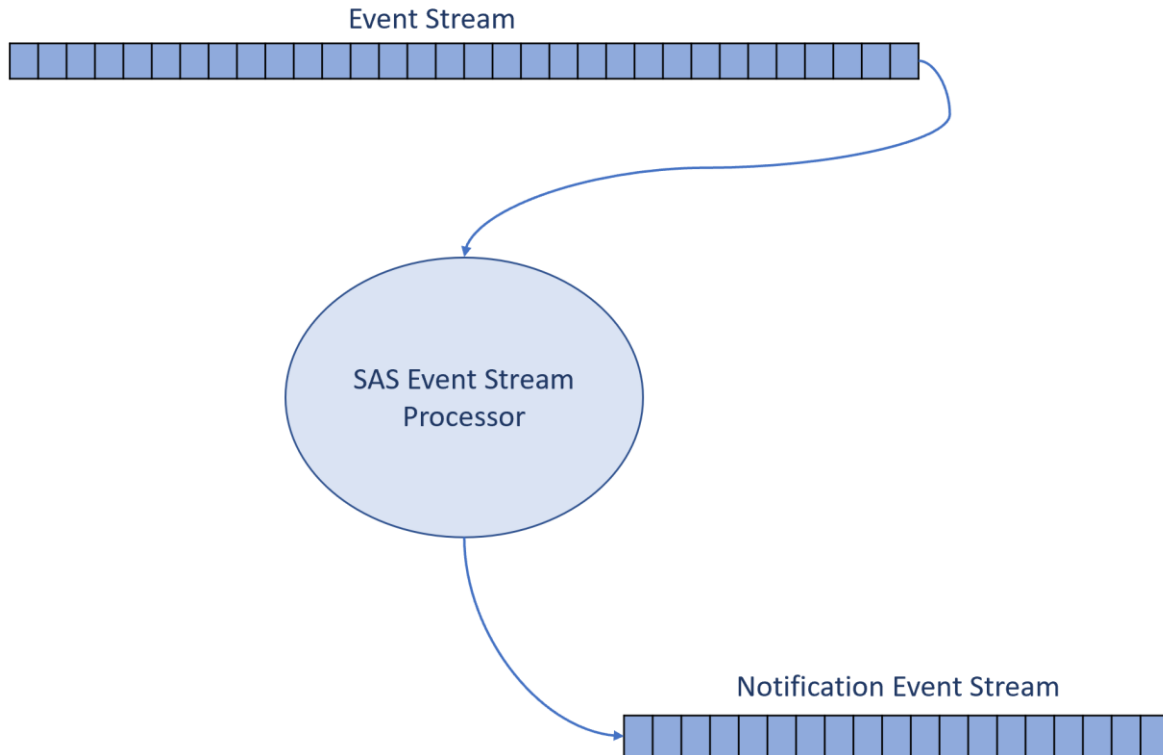


Figure 3. SAS Event Stream Processor subscribes to event streams, and through complex stateful event stream processing, generates a notification event stream in real time

A closing remark on SAS Event Stream Processor; In this paper SAS ESP is discussed as a component in a real time marketing value chain, but with its powerful real time processing capabilities means that there are use cases far beyond marketing. Stateful event processing means that tasks that traditionally fall within batch processing and Data Warehouse now can be done in real time in the data stream. This can have far reaching effects on how businesses set up their information architecture. At Telenor, SAS Event Stream Processor amongst other things used for real time data management.

COMBINED USE AT TELENOR

Let us return to Telenor and the world of telecom. So far, we have briefly discussed how SAS Real Time Decision Manager can listen to single events and efficiently implement real time targeted campaigns and a unified marketing strategy. The previous section stated that SAS ESP can identify complex patterns of interest in continuous event streams and create a notification event when a pattern is identified.

At Telenor, SAS Event Stream Processor and SAS Real Time Decision are used in conjunction, where SAS ESP identifies complex patterns within streams of data and SAS RTDM subscribes to its notification events in order to trigger targeted marketing campaigns in real time.

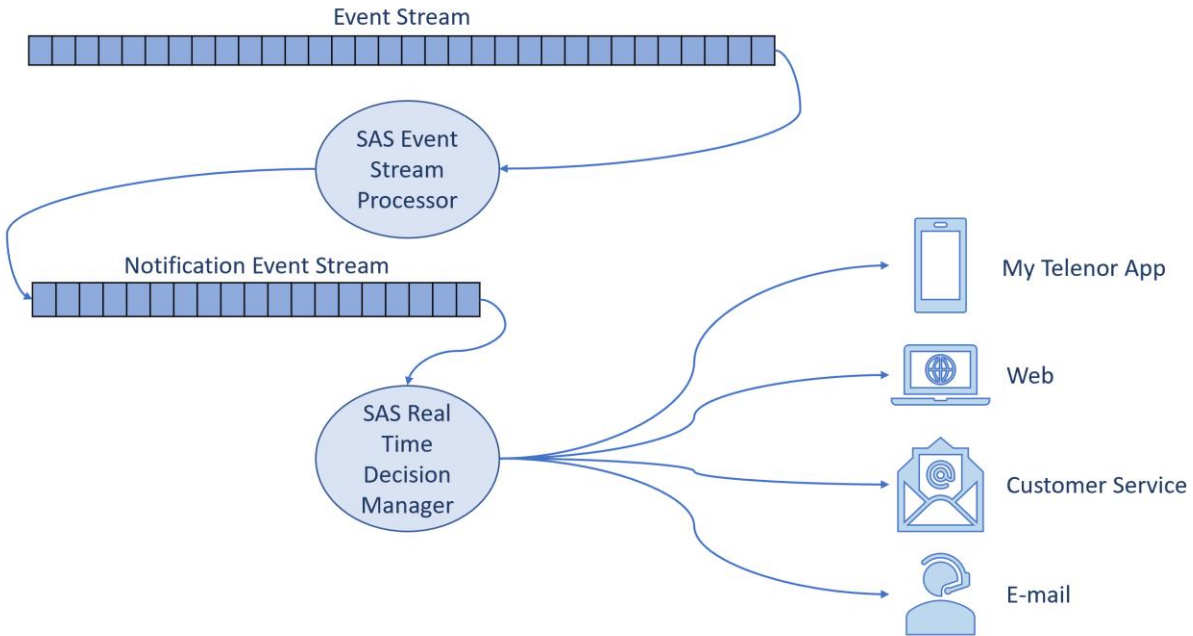


Figure 4. SAS Event Stream Processor continuously searches for complex patterns in event streams, and subsequent notifications trigger a real time unified omnichannel response through SAS Real Time Decision Manager

The difference between the original event stream and the generated notification event stream is that the former requires complex stateful stream processing, while the latter can be processed effectively as a stateless phenomenon. The throughput, or events per time period, is considerably smaller in the notification event stream compared to the original event stream.

But that begs the question, what kinds of data streams are of interest?

In the following examples, note that some of them require stateful stream processing to be addressed in real time.

- Change in behavior: if a customer’s behavior changes, this can be indicative of higher churn probability.
- Data usage: if a customer often exceeds their mobile data quota, or are far from using up their data quota, then another subscription may be more suitable for them.
- Anomaly detection: certain patterns of customer behavior, such click-stream data and contact history, may be indicative of fraud or abuse.
- Subject and Sentiment analysis in stream.

SUBJECT AND SENTIMENT ANALYSIS IN STREAM

Language, both written and in speech, can be encountered as a real time event stream. In the same way that an abnormal heart rhythm cannot be identified by a single heartbeat, the sentiment and subject of text cannot be derived from a single word or even a single sentence. This suggests that you need a tool capable of complex stateful real time

processing to adequately react to text in real time. Sounds familiar? SAS Event Stream Processor is up to the task with its natural language processing capabilities.

We humans are experts in processing language in real-time, and we often forget that it is quite a complex task. To this day it can be challenging enough to extract the subject and sentiment from text or speech using algorithms in batches, but with SAS ESP natural language processing, they can be extracted in real time by continuously listening to data streams. Imagine that your customers are in contact with Telenor (for instance, social media, my app, text, or email), and that you automatically want to identify the subject and sentiment of the communication.

SAS ESP can identify subjects and sentiments with a certain probability. The output can then join the two analyses to couple sentiment and subject together.

Customer	Subject	Sentiment
Arne	Subscription	Positive
Bjarne	Customer Service	Negative
Christine	Customer Service	Positive
Dario	My Telenor App	Negative

Table 1. Example Output from SAS ESP Natural Language Processing

The output from SAS ESP can be used to identify what customers are talking about and how they are feeling, giving you valuable insights into your customers and your own organization. Are customers satisfied with the My Telenor App after the recent changes? Why are certain customer groups negative towards customer service? Output like this can be used to continuously evaluate and analyze your interaction with customers.

Imagine that your team of analysts identifies that certain combinations of subject and sentiment are highly correlated with customer churn or with an up-sale opportunity. Previous attempts to address this through daily batch scoring reveals that many opportunities are missed because you fail to reach out to the customer in the heat of the moment.

To address this issue, SAS Real Time Decision Manager can subscribe to notification events that SAS Event Stream Processor continuously produces as certain combinations of sentiment and subject are observed.

Customer	Subject	Sentiment	To do
Arne	Subscription	Positive	Offer subscription upgrade in My Telenor App, Web etc.
Bjarne	Customer Service	Negative	Churn-preemptive, call the customer
Christine	Customer Service	Negative	Nothing
Dario	My Telenor App	Negative	Nothing

Table 2. Certain combinations of subject and sentiment require immediate action

Note that the columns Customer, Subject and Sentiment are identified by SAS Event Stream Processor, while To Do is a decision that is made in SAS Real Time Decision Manager. But why do we need SAS Real Time Manager to make the decision; surely SAS ESP with its complex pattern recognition can identify an appropriate response?

Let us consider this for a moment and notice that Christine and Bjarne are observed with the same combination of subject and sentiment, but they are not subjected to the same response. This indicates that some decision rules conceptually lie outside the sentiment event stream. At Telenor, it is important that the customer is not overwhelmed by a variety of marketing campaigns. Too many emails, text-messages, different banners on the web or in the app have the potential to overwhelm the customer. Not only do you fail to deliver unified and relevant content, thereby missing sales opportunities, but it can also have a negative impact on churn and sales, making matters worse. In addition, some customers are expensive (negative life time value), while others are customers are suspected of fraud, meaning that certain campaigns are not relevant for certain customers.

These are exactly the issues and challenges that SAS RTDM and its underlying Common Data Model are designed to address. By including SAS RTDM in the real time value chain, the complex pattern recognition in SAS ESP is readily included in a unified marketing strategy. On the flip side, SAS ESP extends the capabilities of SAS RTDM to be able to react to complex event stream patterns.

Before closing, I would like to remind you of two natural “next steps” in creating automated and real time customer interactions.

The first relates to the algorithms and models involved in the predictions of all things. In short: if you have hundreds or thousands of continuously-changing models at work, you need to automate the model maintenance work, too. This relates to model development, deployment, evaluation/retraining/re-deploying etc. In SAS, boosting model building productivity is addressed by:

- Factory Miner (-an EM add-on)
- Model Manager

The second relates to the fact that data engineering and data management are crucial success factors. Architectural choices, parameter settings and tweaking can reduce data load time from 7 hours to 7 seconds, as demonstrated by the SAS team at Telenor! The real point here is that a solution is only as good as the data you have timely access to! Real time solutions depend heavily on engineering and data management skills.

CONCLUSION

SAS Event Stream Processor and SAS Real Time Decision Manager both have real time capabilities, and their different capabilities and real time perspective complement one another. At Telenor, the combined used is an integral part of their day to day real-time communication routine.

SAS ESP extends the capabilities of SAS RTDM to trigger real time targeted marketing campaigns based on complex event stream patterns. On the flip side, SAS RTDM helps SAS ESP to include the observed patterns in a unified omnichannel marketing strategy.

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RECOMMENDED READING

- <https://www.sas.com/content/dam/SAS/support/en/sas-global-forum-proceedings/2018/1962-2018.pdf>
- <https://support.sas.com/resources/papers/proceedings16/10120-2016.pdf>
- <https://support.sas.com/resources/papers/proceedings17/1387-2017.pdf>

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