



Ask the Expert

Machine Learning Models in SAS Event Stream Processing (ESP) - How to integrate and execute on the Edge

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Steve Sparano, Principal Product Manager, SAS

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Agenda

Introduction

New Business Drivers

Streaming Analytics

SAS Event Stream Processing (ESP)

Machine Learning on the Edge

Demo

Q&A



“One of the big growth opportunities we see is the Internet of Things. SAS has the power to generate significant value for our customers and significantly shape this market—not only as the leader in advanced analytics, but with our ability to position our analytics at the very edge of IoT devices. The IoT comes to life not only by connecting devices, but by deriving insight from the data these devices generate through analytics.”

- Jim Goodnight

Sanjeev Heda



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Internet of Things (IoT) Division

Senior Industry Consultant

Sanjeev Heda is a Senior Industry Consultant for SAS Institute's Global IoT Division. He provides thought leadership and expertise to drive advanced analytic solutions across industry in support of the Internet of Things. He helps customers uncover value and drive improved business outcomes from the growing volume of connected devices, with a specialized focus on improving service delivery, asset utilization, equipment reliability and overall product quality. In addition, Sanjeev works closely with product marketing and sales teams to ensure the SAS technology direction and solutions meet the needs of the market.

Prior to joining SAS, Sanjeev worked for the General Electric Company for 12 years with 9 years in the Data and Analytics team for Power. He brings deep domain experience in equipment condition monitoring, reliability, and the life cycle of analytics having served as a Technical Leader for the Data and Analytics team. He is a certified Six Sigma Green Belt and holds a B.S. and M.S. in Mechanical Engineering from the Georgia Institute of Technology.



New Business Drivers

New Landscape – New Needs



Bigger Data

- Volume
- Velocity
- Variety



Act Faster

- *Reduced time to decision and action*
- *Immediate low latency answers*
- *Continuously evaluate opportunities and risk*
- *More agile, more responsive*

Artificial Intelligence

is the science of training systems to emulate human tasks through Learning and Automation



Understand
Context



Learn
Patterns



Recognize
Objects



AI + IoT

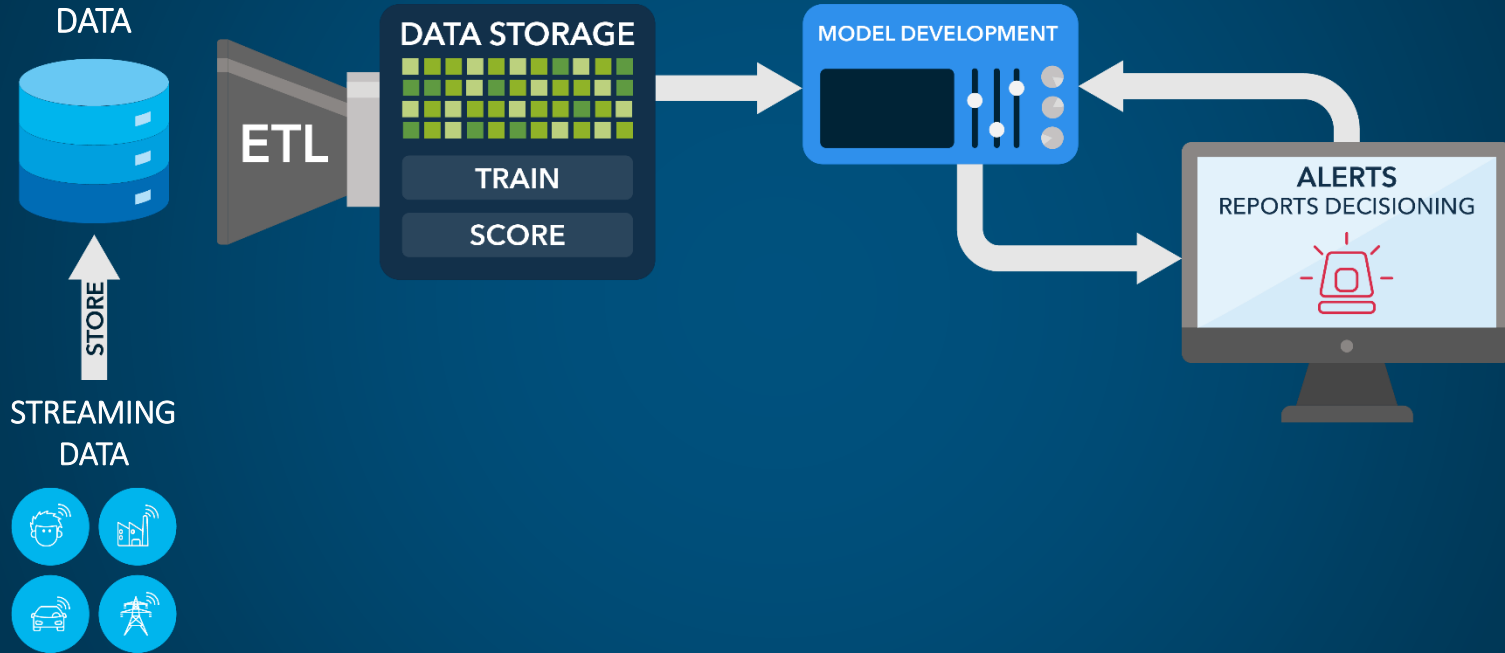
Artificial Intelligence of Things



Streaming Analytics

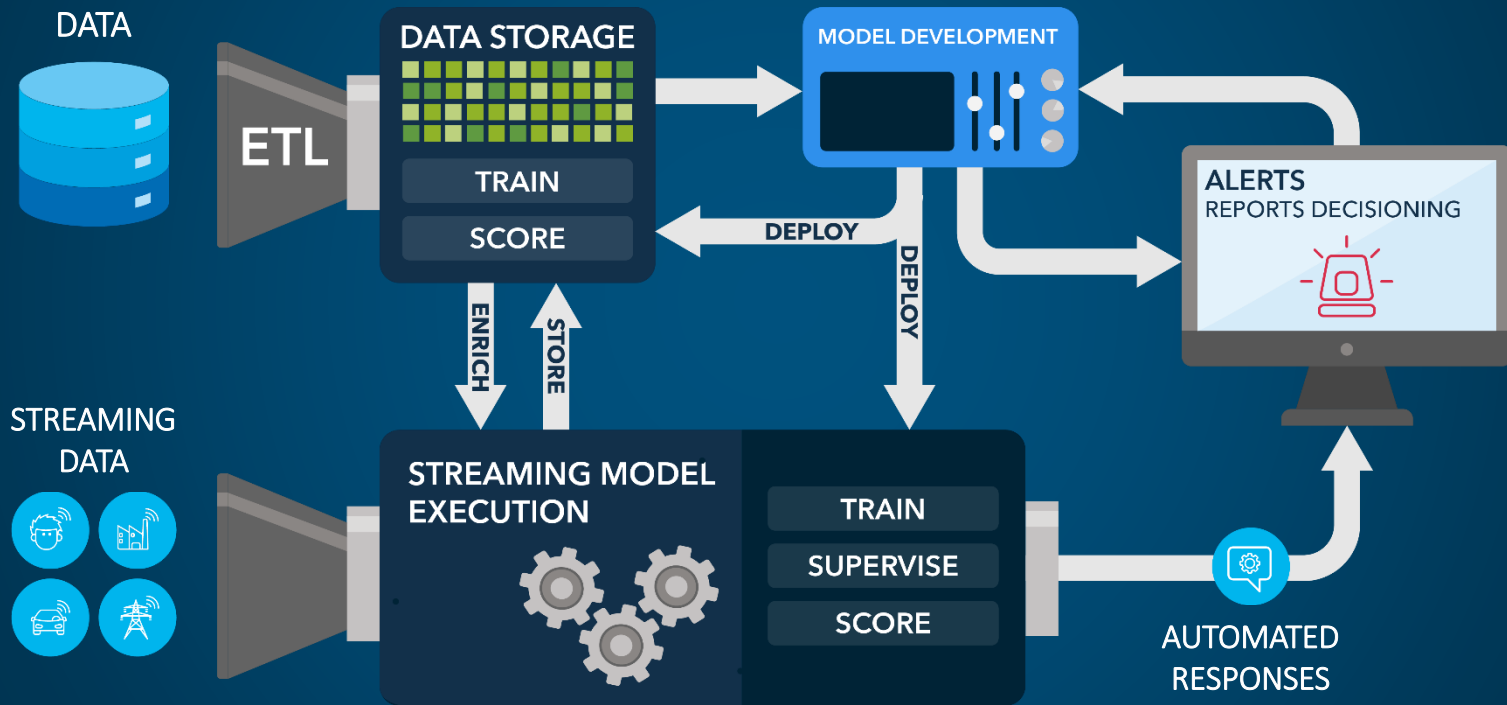
Traditional Analytics Lifecycle

Access – Store - Analyze



IoT Analytics Lifecycle

Inclusive of Big Data, AI/ML, Streaming, Edge



Streaming Analytics



Multi-Phase Analytics in-stream, out-of-stream, and edge

Reduce time to decision for better business outcomes

High-Performance execution

Open APIs, SAS and Open Source model support

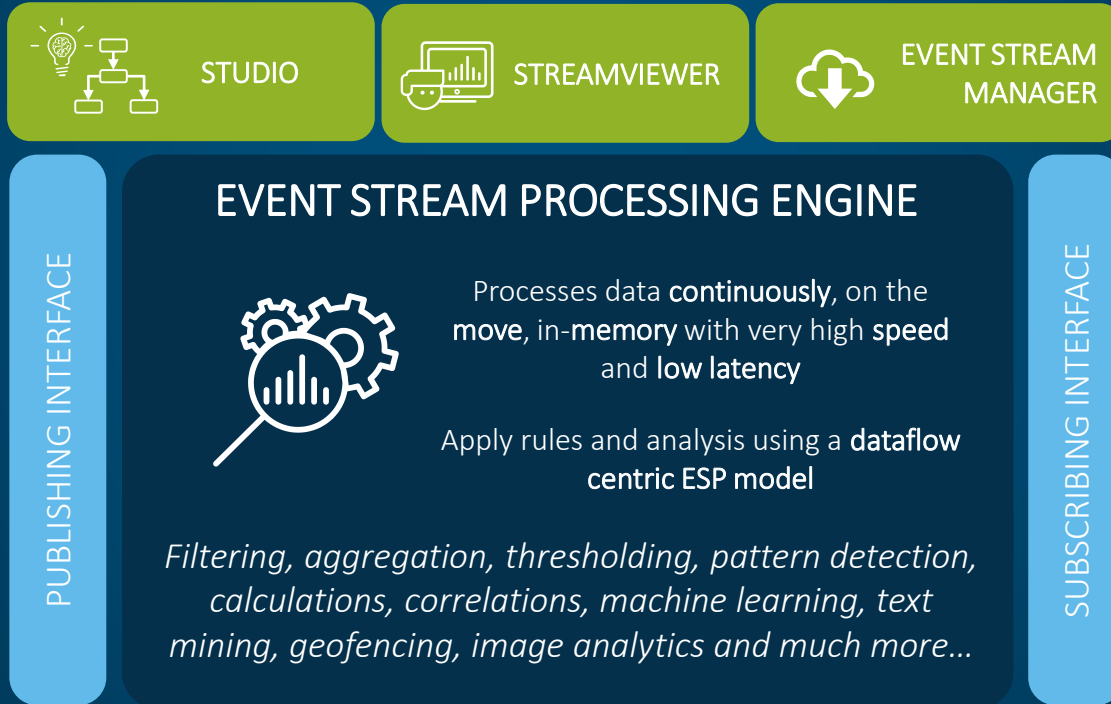
Event Stream Processing (ESP) delivers streaming analysis for low-latency decision making in-stream, out-of-stream, or on the edge



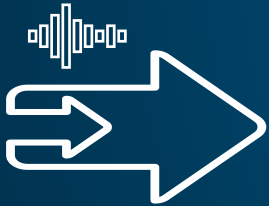
SAS Event Stream Processing (ESP)

SAS® Event Stream Processing

Functional Architecture



*Streaming
Data*



PUBLISHING INTERFACE

EVENT STREAM PROCESSING ENGINE



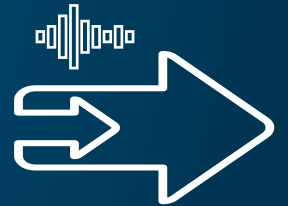
Processes data **continuously**, on the **move**, in-memory with very high speed and **low latency**

Apply rules and analysis using a **dataflow** centric ESP model

Filtering, aggregation, thresholding, pattern detection, calculations, correlations, machine learning, text mining, geofencing, image analytics and much more...

SUBSCRIBING INTERFACE

*Streaming
Data*

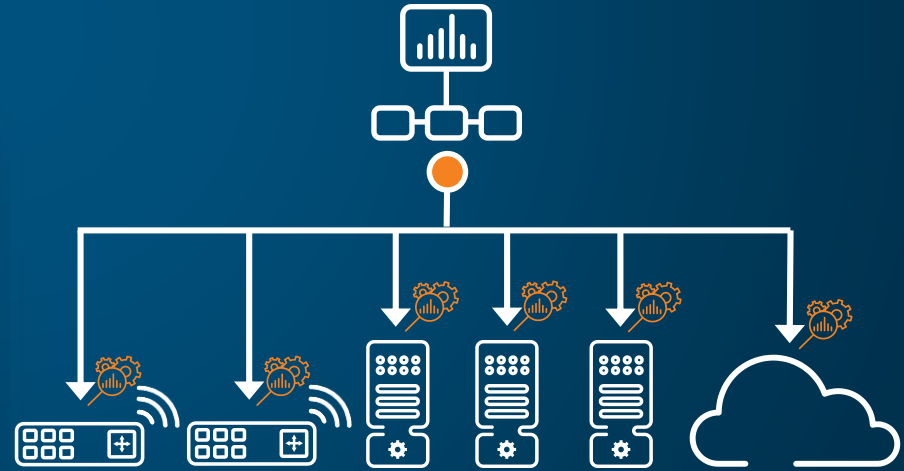
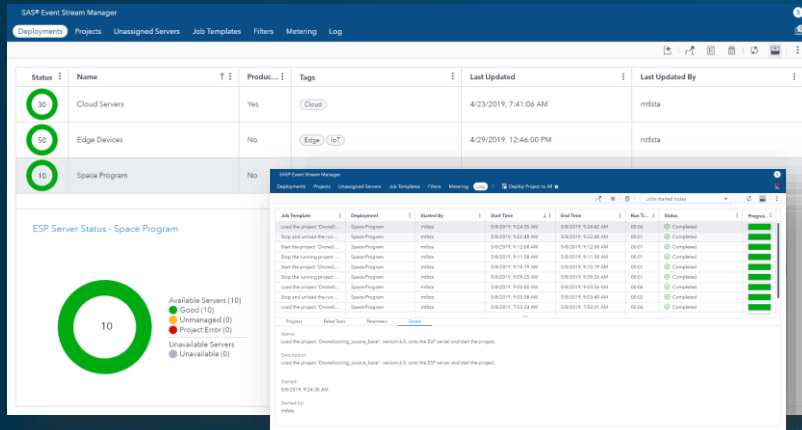


SAS® Event Stream Manager

Operational Management

- Manage edge, on-premises or cloud deployments
- Engine grids monitoring
- Projects and templates management
- Jobs and Tasks Management
- Plan versioning
- Support for dynamic model updates

Deploy, monitor, manage
production models



SAS® Event Stream Processing

Open and Flexible

Interface

REST and WebSocket

Python PUB/SUB API

Java PUB/SUB API

C PUB/SUB API

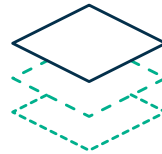


A new design layer

ESPPy

- Design streaming models in Python
- Interrogate engine and pull data into Python native structures from ESP running projects

developer.sas.com

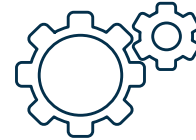


Execute in process

SAS® DS2

Python

C++ / C



SAS® Event Stream Processing

High End Streaming Analytics

In-Stream Analytic Model Deployment

SAS® DS2, Python, C
SAS® ASTORE Scoring support
SAS® Model Manager Integration

Streaming Algorithms & Machine Learning

Streaming Summary - Univariate Statistics
Streaming Pearson's Correlation
Streaming Segmented Correlation
Weibull Distribution Fitting
Short Time Fourier Transform
Streaming Text Tokenization/Vectorization
Term Frequency – Inverse Document Frequency
Streaming Audio Feature Computation
Streaming Speech Transcription
Moving Relative Range
Change Detection
Lag Monitoring
Cepstrum Transformation

Streaming Fit Statistics
Streaming ROC
Streaming Histogram
Subspace Tracking (SST)
Image Processing
Video Encoding Text Analytics *
Random Forest*
Gradient Boosting Tree *
Support Vector Data Description*
Deep Neural Network*
Convolutional Neural Network*
Recurrent Neural Network*
Bayesian Network*

General Linear Model*
Generalized Linear Regression*
Butterworth Filter*
Robust Principal Components Analysis*
Stability Monitoring Scoring*
Generalized Additive Model*
Semantic Segmentation*
Bayesian Network*
Generalized Linear Multi-task Learning*
Support Vector Machines*
Dirichlet Gaussian Mixture Model *
Streaming Linear Regression* +
Streaming Logistic Regression* +
Factorization Machine(recommender)*+
Streaming K-Means +
Streaming DBSCAN +
t-Distributed Stochastic Neighbor Embedding +
Streaming Support Vector Machines +

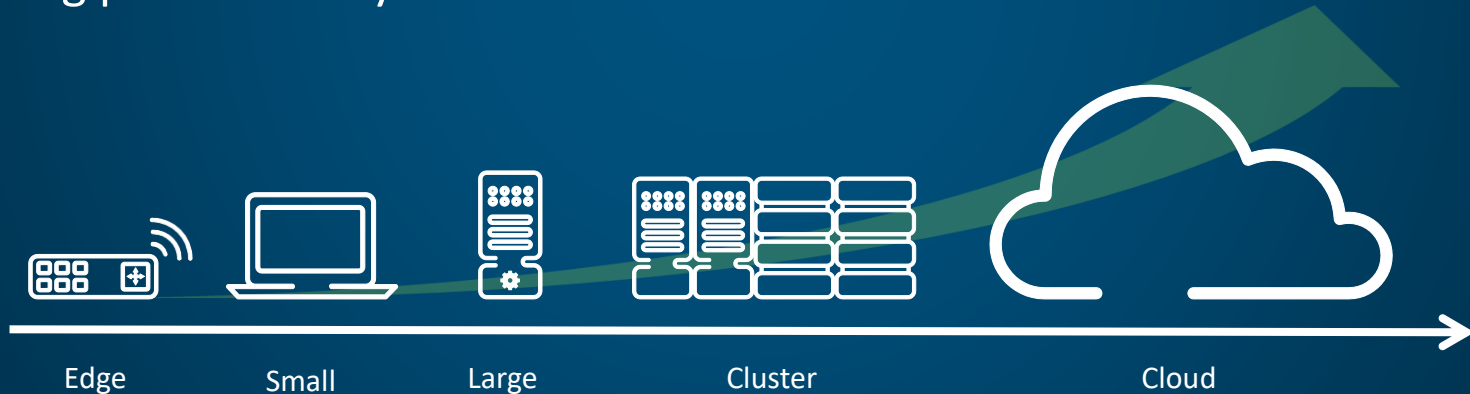
* *Out-of-Stream Training & In-Stream Scoring*
+ *In-Stream Training and In-Stream Scoring*



SAS® Event Stream Processing

Engineered for Agility

- Small footprint OS native application
- Supports lightweight embedded technology to cloud distributed architecture
- Fulfill edge-to-enterprise IoT architecture needs
- Growing partner Ecosystem

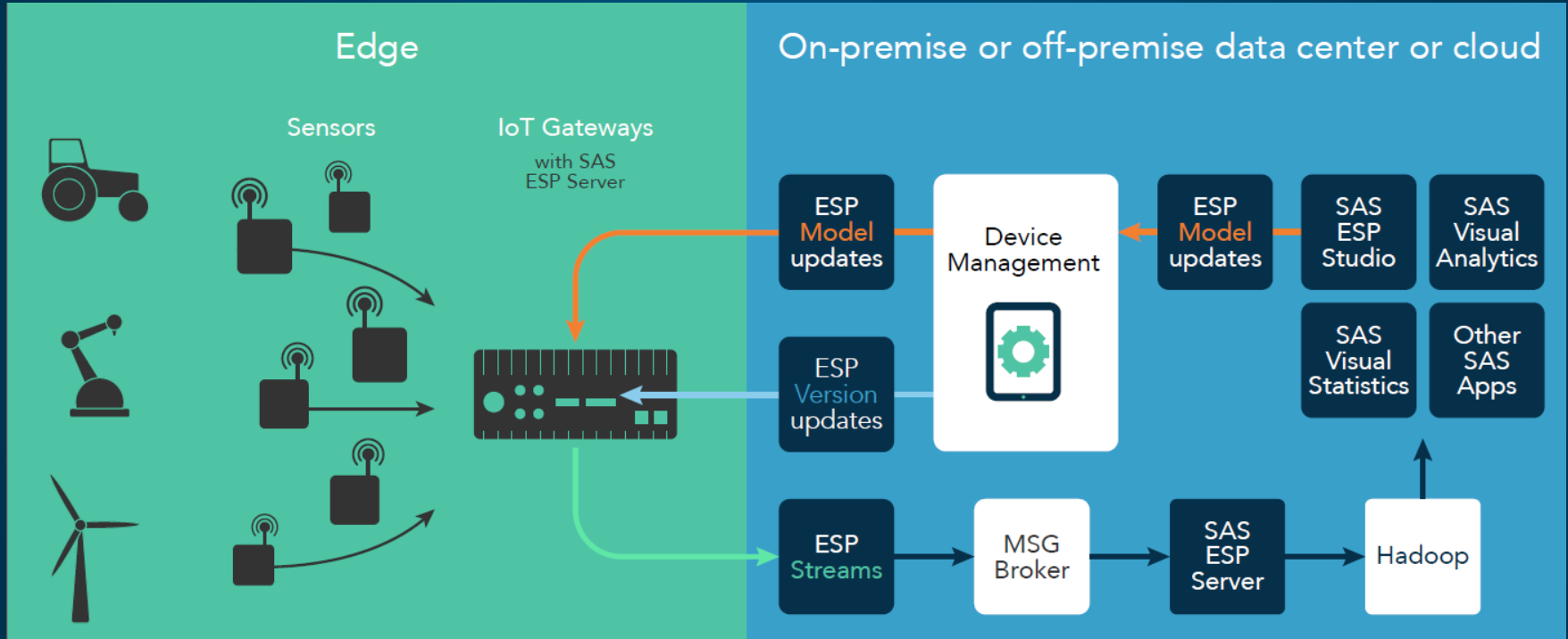




Machine Learning on the Edge

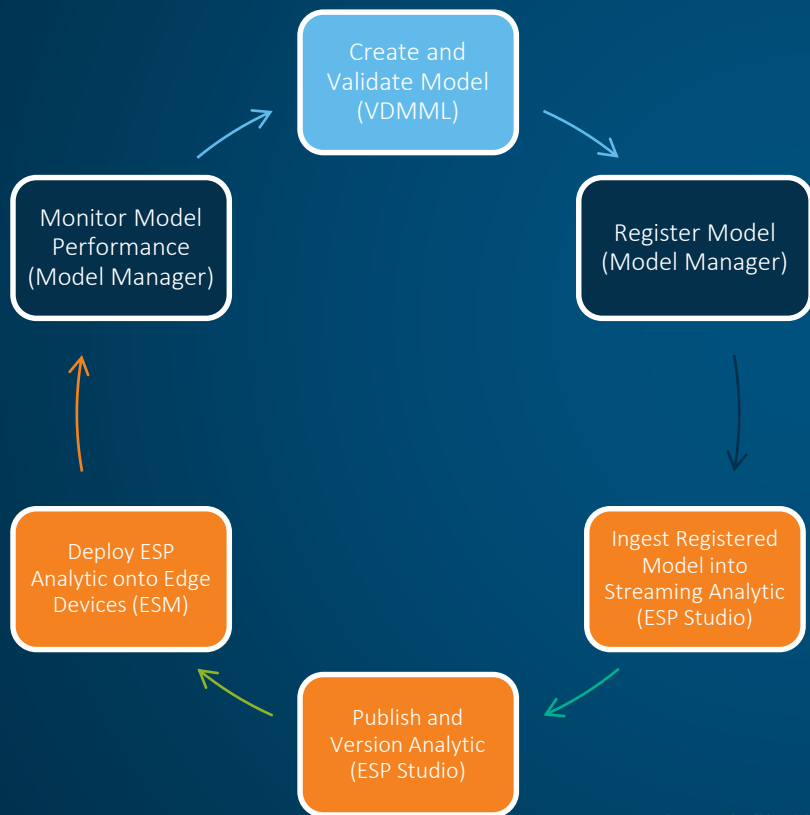
Edge to Cloud Streaming Analytics

Reference Architecture



SAS Analytic Ecosystem

Offline Analytic Model Deployment to Edge Devices



- Model Manager provides governance and lineage of Registered Models
- Streaming Analytics enables the processing of Model outputs to drive actionable information
- Event Stream Manager (ESM) provides deployment and monitoring capabilities

This is a **continuous cycle** as the Model requirements and performance evolve over time



Demo

Get a Free 30-Day Trial of SAS® Event Stream Processing (ESP)



**Zero to SAS ESP
in 60 seconds!**

Start Your Free Trial of SAS ESP Today!

Quickly build streaming projects using real-time data and machine learning to gain immediate insights for accurate and timely decision making with SAS ESP on the SAS Analytics Cloud

<https://www.sas.com/esp>

Join the SAS IoT Community to share experiences and learn from other SAS ESP experts.

Visit <https://communities.sas.com>

Under the “Find a Community” button, click on “Analytics & Statistics” and select SAS Analytics for IoT.

