NEURON ESB FIELD SERVICES | SOLUTION SERIES

Solutions for Connected Enterprise (Oil & Gas):

Exception-Based Surveillance

This white paper series examines some of the most prevalent business and technical integration challenges facing clients today, and how Neuron ESB effectively and efficiently addresses those challenges.

This white paper specifically describes the value of having an Exception- Based Surveillance (EBS) system for an Exploration & Production (E&P) organization. It also illustrates the reference architecture and technical details for implementing an EBS solution using Neuron ESB middleware.

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Executive Summary

In response to rapid production growth and the increasing size and complexity of asset portfolios, oil and gas operators are turning to Exception-Based Surveillance (EBS) to reduce lease operating expense, decrease deferred production, reduce non-productive time, alleviate hiring constraints, and improve cash flow in today's uncertain environment.

EBS is a signal-based operating model that utilizes remote monitoring capabilities through control systems to proactively identify unplanned production disruptions and focus personnel time on value-added tasks. The model primarily involves *(Figure 1):*

- Monitoring of signals from control systems and critical operational data
- Identification and recording of problem scenarios (exceptions) based on pre-defined rules
- Initiation and tracking of appropriate business process to resolve the exception based on Standard Operating Procedures (SOP).
- Performing analytics for monitoring system health and improving the model

Figure 1: *EBS Process Flow*

Key Benefits

- Improved production availability via optimization and reduction in deferred production
- Controlled headcount increases
- Reduction in spills due to more proactive and preventative activities
- Reduced drilling rig communications costs and non-productive time (NPT)
- Higher visibility to critical operational data

The Connected Enterprise

The notion of a digital oilfield is evolving to a vision of integrated operations, i.e., applying computer and information technology to the technical and business aspects of upstream oil and gas with the ultimate objective to improve efficiency, reduce costs and realize new value.

Exception-Based Surveillance (EBS)

Improvements in drilling and completion techniques have unlocked resources which were not considered economical, only a decade ago. Along with these opportunities, operators are presented with ever-increasing challenges to effectively manage rapidly expanding production operations and optimize costs in today's volatile price environment, driving them to develop an operating model that effectively supports projected production growth while reducing losses.

Drivers

Some of the key operating challenges posed by rapidly increasing well counts and production include:

- Improving workforce efficiency and reducing costs
  - Increase well-to-personnel ratio
  - Reduce non-standard work
- Need for better production surveillance
  - Asset portfolios getting bigger and complex
  - High cost of equipment/well failures
  - Potential cost of lost production
  - Greater risk of safety-related incidents

The EBS Model

An EBS system relies on signals generated by remote monitoring capabilities through Device/Process Control systems. Alerts are raised when signals are out of acceptable range or fail pre-defined business rules, and trigger workflows that bring together various personnel to collaborate, diagnose and remediate as required.

For example, if the system captures a production flow reading that is abnormally high or low, this could trigger an exception signal to check a well site. This differs from traditional models which typically send operators to "every well, every day" to capture meter readings and reactively check for issues.

Business Case for EBS

- Workforce efficiency is improved by shifting the team's focus from primarily collecting production data and reactively performing maintenance to spending more time performing preventive maintenance and minimizing disruptive non-value added activities (e.g. drive time, data collection, reacting to false alarms, and rework). This enables greater well coverage and efficiency, without increasing headcount. *(Figure 2)*

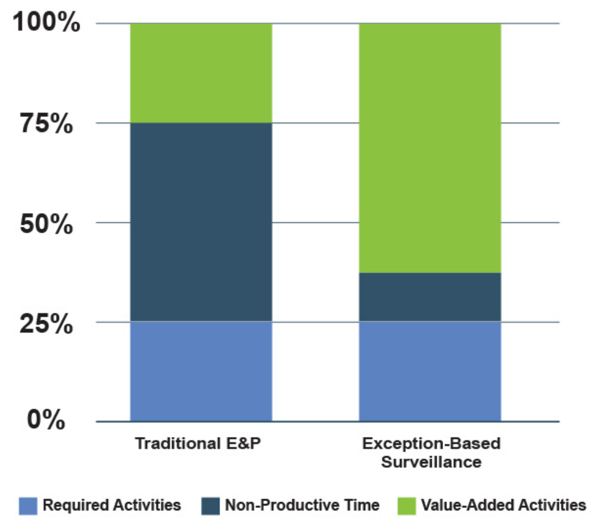

Figure 2: *Workforce efficiency*

- Ability to minimize deferred production by reducing maintenance downtime through more preventive maintenance. Remote monitoring allows additional time for field teams, which can subsequently be used to proactively perform maintenance on other assets. *(Figure 3)*

Average Expected Daily Production (bbl)	10,000
Average Deferred Production (~7.5%)	750
Average Deferred Production under EBS (~5.0%)	500
Production Uplift under EBS (bbl)	250
Crude Oil Sales Price	$50-80
Projected Daily Production Revenue increase under EBS	$12,500-20,000
Projected Annual Production Revenue increase under EBS	$4.56-7.30 million

Figure 3: *Advantages of Exception Based Surveillance*

- Helps address Health, Environment & Safety (HES) challenges – e.g. reduction in operational risks and worker safety (reduction in drive time); prevention and/or early detection of environmental incidents; improve accountability, auditing and regulatory reporting.

Prerequisites

Although EBS provides a scalable operating model that helps reduce total operating costs, there are a few key considerations to execute an effective EBS program:

- Wells must be stabilized, and exception activity must be within acceptable range. If not, team's time will be more consumed in responding to exceptions than in performing value-added activities.
- High degree of functionality and reliability in remote monitoring network.
- Creating a sustainable change management plan/ program to support all affected stakeholders.

Reference Solution

The execution flow of an EBS system primarily involves:

- Receive signals and critical operational and master data from Line-of-Business (LOB) applications.
- Define business rules / conditions and related parameters to identify exceptions.
- Monitor source data, identify and record exceptions based on the pre-defined rules, and raise alerts.
- Initiate and track appropriate business process workflow to resolve the exception.

Figure 4 shows a logical reference architecture for an enterprise using an EBS platform.

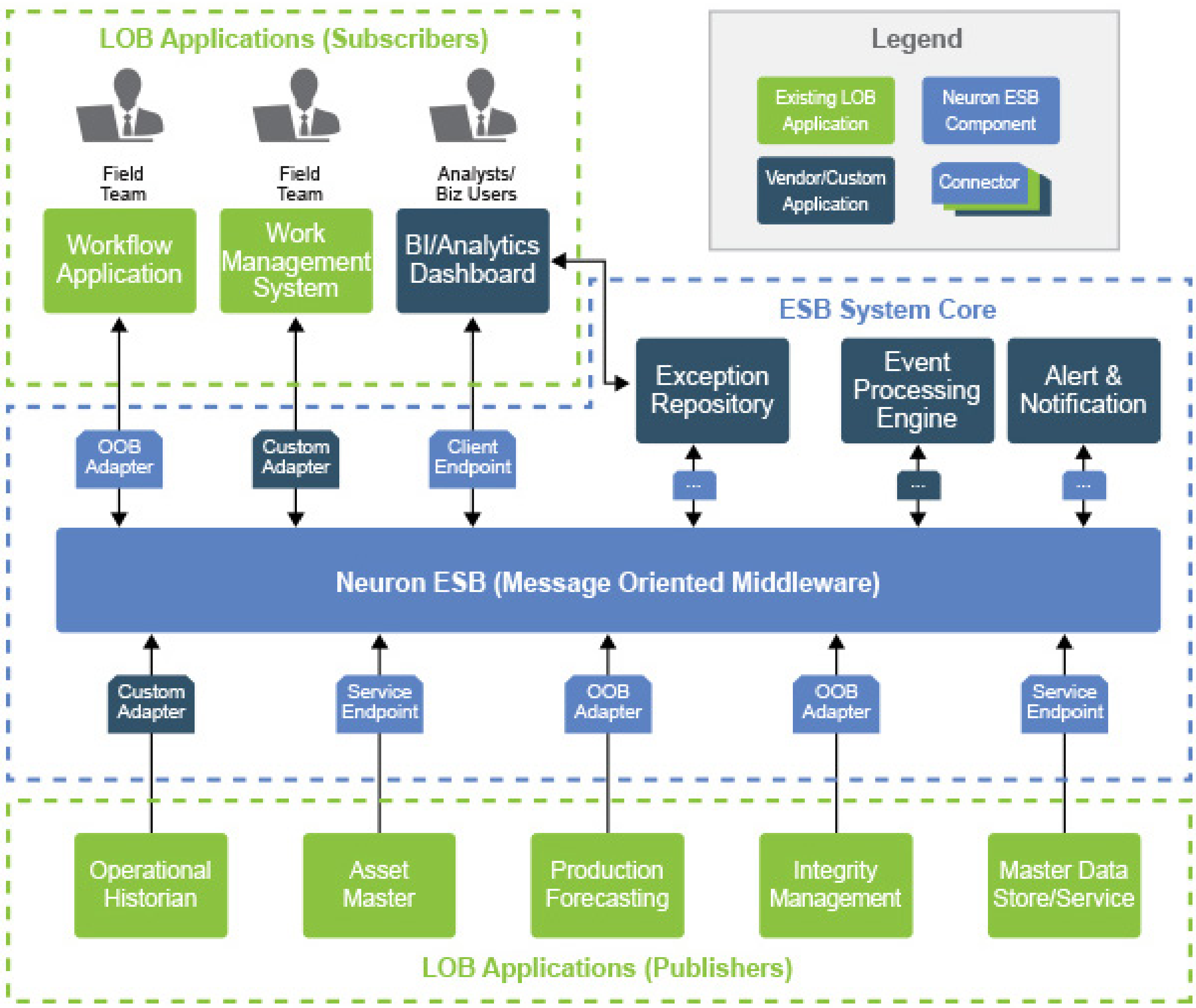

***Figure 4:** Reference Solution Architecture*

Key Components

The key components of the EBS platform are:

LOB Applications (Publishers)

- **Operational Historian** (e.g. OSISoft PI®): Historian is the source of signal data from the field. Typical signals that EBS could be interested in are – Flowline Pressure, Production Volume (Oil/Gas/Water), Casing/ Tubing Pressure, etc.
- **Asset Master** (e.g. WellView®): Data store for all Well information – (for e.g. well master data, daily production data, casing & tubing report, etc.).
- **Production Forecasting** (e.g. OFM®): System that provides production forecasts for each well.
- **Integrity Management** (e.g. IMSA®): Manages IM plans, risk scores and related information for assets. Used for prioritizing exception; instantiating workflow; creating work orders.
- **Master Data Store/Service:** Provides a repository for reference data, and mappings for records across systems. Typically these are home-grown solutions or a subset of one of the LOB applications.

LOB Applications (Subscribers)

BI/Analytics Dashboard (e.g. Tableau®):

Employed by business users to view system health, business process reports, trends, exception tracking etc. Potential scenarios include:

- Trends – Production Profile
- Business Process Tracking – Open/Close workflow items by region, team, field, type, etc.
- KPI/Management – Cycle Time by Workflow Stage, Production Availability, etc.

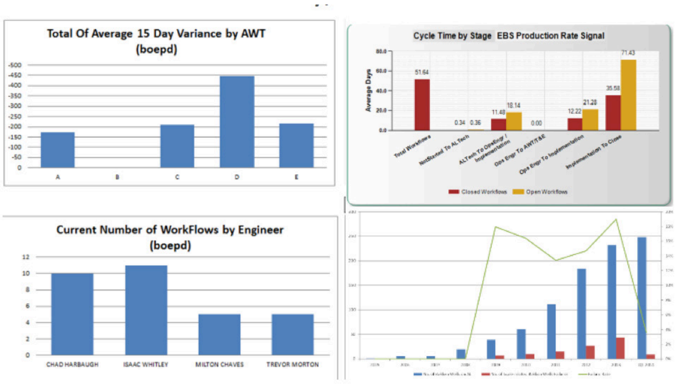

Figure 5: *Sample BI Reports*

Workflow Application (e.g. K2®):

Tracks and manages business process instances while users perform functions based on SOPs for handling a particular exception. Also provides a User Interface for users, giving role-based access to view and manage assigned workflow tasks.

Work Management System (e.g. SAP PM®):

Manages maintenance plans/work orders/schedules for field teams. Based on business process stages from Workflow Application, it might be necessary to create work orders for field team for immediate action.

EBS System Core

This sub-system is responsible for receiving and consolidating data from various sources and identifying exceptions. Once the exception data is extracted and formatted, it is sent to the Workflow Application for workflow instance creation and tracking. Major parts of the EBS System Core are:

Neuron ESB (Enterprise Service Bus)

This is the communication backbone of the solution, responsible for moving data between different modules and publishers/subscribers. There are three major aspects of Neuron ESB that are used in the EBS solution:

- Routing Engine – Communication backbone for the solution, which provides a Topic-based pub/sub messaging system in which Parties send (publish) messages to and receive (subscribe) messages from Topics.
- Neuron ESB Business Processes – Provides process orchestration capabilities for message processing and/or to implement specific integration patterns (e.g. VETO).
- Connectors – Used to connect the messaging components to external applications, protocols, transports or databases.

Event Processing Engine (e.g. Microsoft StreamInsight®)

The goal of the Event Processing Engine is to track and analyze streams of information from one or more sources, and infer relevant events/patterns to derive a conclusion. Event processing could be classified as Simple (monitor streams in isolation and identifies events based on simple predefined rules) or Complex (monitor multiple streams and infer events based on aggregation or pattern detection).

In context of EBS, the EPE is responsible for monitoring the data feeds published by LOB applications onto the Enterprise Service Bus; raising exceptions and publishing to the Bus when relevant events/patterns are identified. Below are some sample rules that an EBS system might execute:

- Actual Production Volume (PV) of wells is consistently exceeding Expected Production Forecast (EPF) over 7 days – Complex
- More than 20% drop in 15-day rolling average Production Rate compared to EPF – Complex
- Pipeline Pressure drops/rises above pre-defined engineering limits – Simple
- Casing/Tubing Pressure for critical assets (flagged in Integrity Management system) goes above/below acceptable range – Simple/Complex

Alerts & Notification

Responsible for sending appropriate alerts/notifications based on the criteria (exception alerts, business process notifications, escalation notices, emails, etc.).

Exception Repository

Storage for identified exceptions, rules data and reference information needed to execute the rules.
In the scenarios involving Complex Event Processing (CEP), it might be necessary to transiently store source event data (e.g. to correlate different events on same well; to correlate events over time; to correlate events among wells in the same field etc.).

Physical Architecture

The physical architecture described below for a reference EBS implementation is not meant to be prescriptive in nature. Rather this should serve as a guidance that offers a standard set of principles for establishing consistent performance, but also provides the flexibility for companies to innovate and establish competitive differences.

Figure 6 shows the reference physical architectural followed by technical details of the key components.

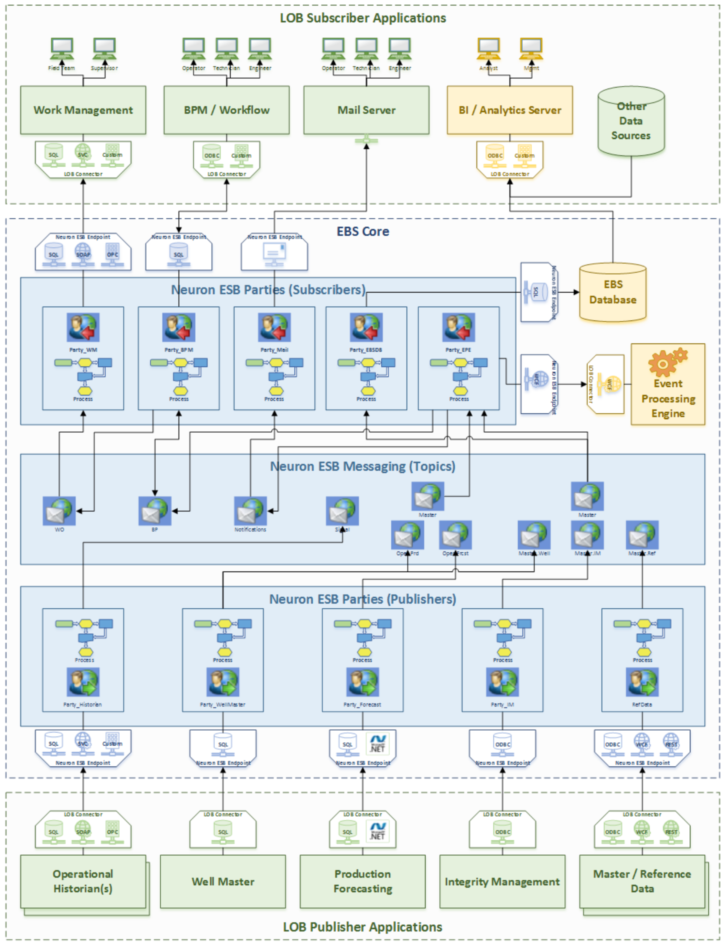

Figure 6: *Physical Architecture*

Publishers & Subscribers

LOB applications and protocols/standards expose publish data to EBS system (Historian, Well Master etc.) as well as applications that work on the EBS exception data (Workflow Application; Work Management) and/or help maintain the health of the enterprise (BI Dashboard). The LOB applications typically have connectors that allow other systems to interact with them (for e.g. SOAP-based service; an ODBC-compliant database or a proprietary protocol / API)

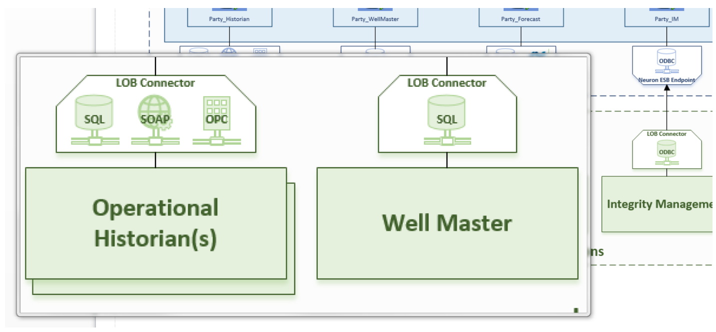

Figure 7: *Publisher Applications*

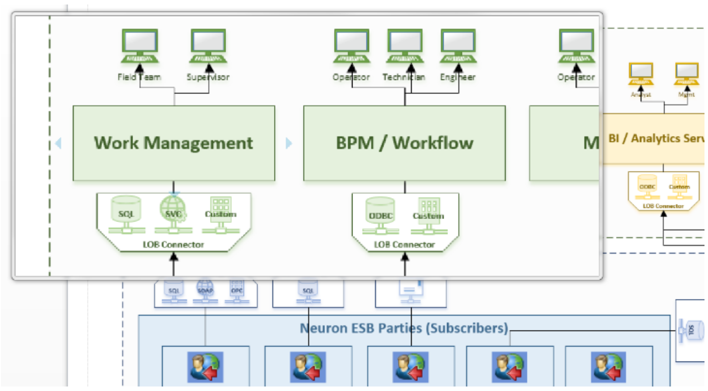

Figure 8: Subscriber Applications

Neuron ESB Parties & Processes

Party is the logical representation of an LOB system within Neuron ESB. Parties use subscriptions to control which Topics they publish messages to, as well as what messages they are interested in receiving from the bus. Some parties (e.g. BPM, EPE) act as both publisher and subscriber. For each party, simple Neuron ESB Business Processes are defined to transform LOB messages from participating systems to a Canonical Data Model or vice versa; and for any message validation/enrichment required.

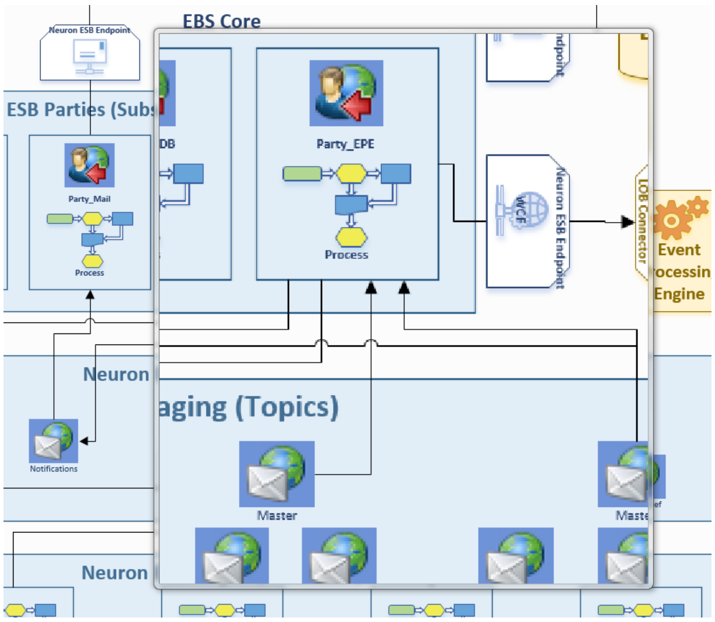

Figure 9: Neuron ESB Party, Process & Connectors

Neuron ESB Connectors (Adapters and Endpoints)

Connectors are the interface to various LOB systems, and each connector is configured to a Party. There is typically one Connector per system, however there might be cases in which a single system needs multiple connectors (e.g. the Asset Master system might provide a web service to access well master data but would have a different means for publishing daily operational data). Depending on the LOB application, one of the following could be used:

- Adapters – native bridge specific to vendor product, protocols or transports, further classified as:
  - Out-of-box (e.g. SAP, SQL Server, MQSeries)
  - 3rd party/Custom based on commonly used product/protocol/standard (e.g. OPC, PI)
- Client Connectors – REST or SOAP based services hosted by the Neuron ESB runtime
- Service Connectors – connect to and route messages from/to existing REST/SOAP services

Topics

Neuron ESB provides a Topic-based publish/subscribe messaging system where publishers (publisher parties) label messages with the Topic name, rather than addressing it to specific recipients. Neuron ESB manages the send of the message to all eligible recipients (subscriber parties) interested in receiving messages on that Topic.

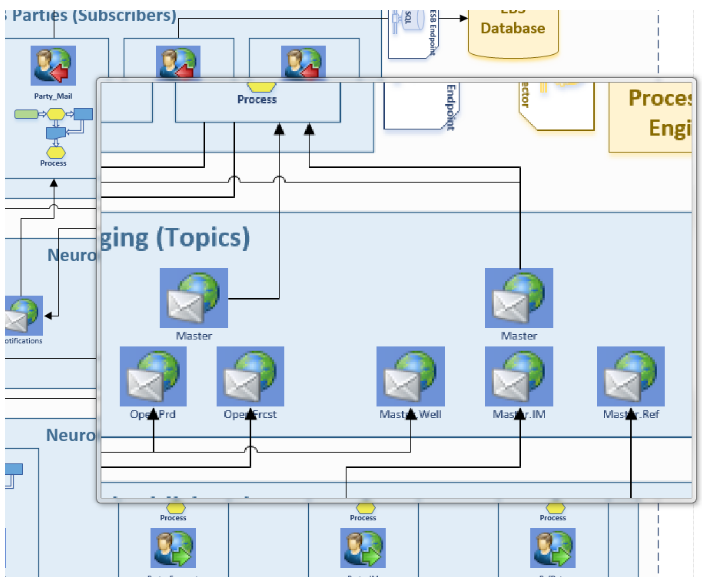

Figure 10: Topics

Within the EBS solution, Topics are created depending on types of messages (Business Process triggers, Work Orders, Notifications, Signals, Ref Data records, Operational Data, etc.) and Quality of Service (QoS) desired. In some instances, like Operational & Master Data, hierarchical topics are defined with publishers sending messages to child topics and subscribers subscribing to top-level topics.

Event Processing Engine (EPE)

In organizations where most of the exception identification requires complex event processing, a robust CEP product (e.g. Microsoft StreamInsight®, IBM WebSphere BusinessEvents® etc.) would be used as the Event Processing Engine. In such cases, the EPE is configured as another party (both publisher and subscriber) in Neuron ESB, and subscribes to all Signal, Operational and Master Data from the bus.

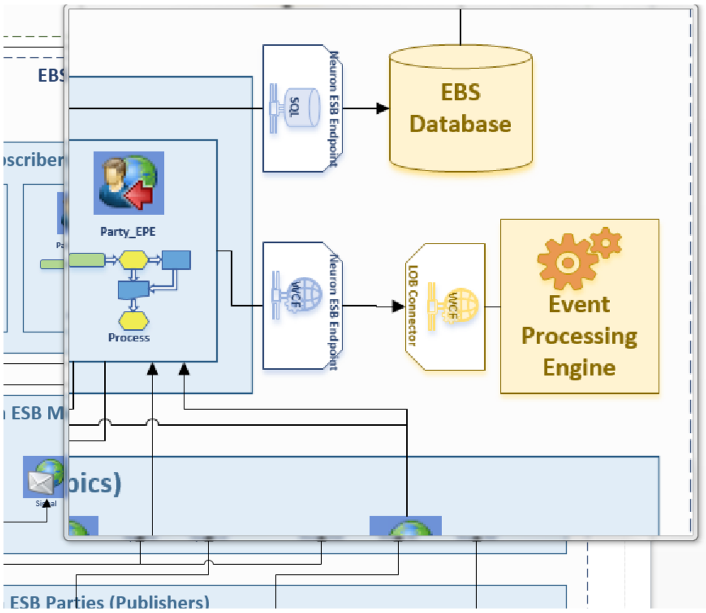

Figure 11: Event Processing

All required Business Rules for identifying the exceptions are configured within the EPE, and the engine identifies and publishes exceptions, along with related data, back onto the bus where it is consumed by the EBS data store.

An alternate implementation, suited towards organizations in which the majority of business rules are relatively simplistic in nature and dependent upon isolated signals, involves utilizing a simple rules engine (e.g. FlexRule, InRule, Neuron ESB Workflow). In such a scenario, the Operational and Master data is published to the EBS data store for transient storage. As the signal data is received by the Party, a Neuron ESB Business Process is executed and the related business rules are executed in real time by calling the engine API as well as fetching the related operational/master data from the EBS data store.

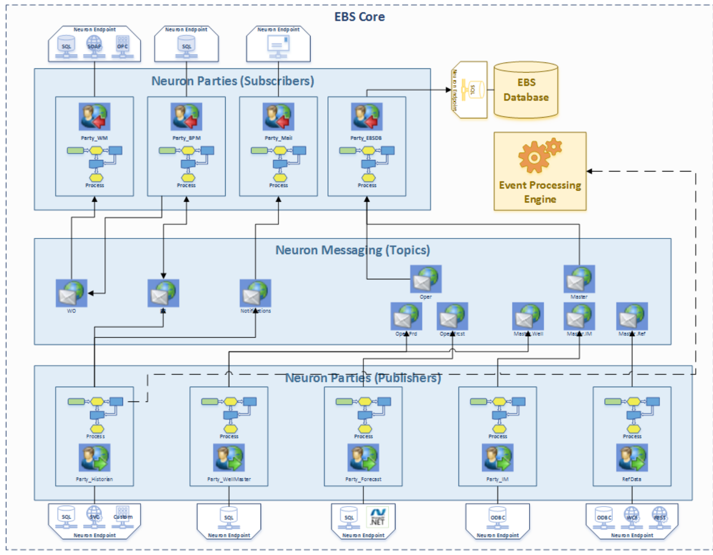

Figure 12: Event Processing (Alternate Implementation)

Beyond EBS?

Once an organization has a well-executed Exception Based Surveillance program, the system could be extended by:

- Moving from rules-based Event Processing to Pattern Recognition (Machine Learning)
- Building a knowledge base of recommendations/ corrective actions to be taken as part Business Workflow execution to resolve an exception. This knowledge base could be used for improving SOPs, maintenance plans, etc.

Conclusion

For E&P companies, Exception-Based Surveillance provides an improved operating model that more effectively manages and scales resources by properly leveraging enterprise data and deploying personnel efficiently. EBS is a departure from traditional models and requires sufficient planning, resources and leadership to implement and sustain.

Why Neuron ESB?

Utilizing Neuron ESB as the core middleware component offers several benefits:

- Streamlined solution implementation, adoption and maintenance – Neuron ESB-based solutions require a dramatic reduction in configuration steps compared to other products.
- Stateless processing environment reduces latency and increases concurrency through asynchronous configuration options.
- Direct interaction with existing web service and application integration adapters.
- Simplified service hosting and mediation.
- Powerful hierarchical, topic-based messaging more intuitively reflects an organization's structure or requirements and allows business to determine the quality of service attributes at Topic level.
- Business resilient Workflow engine provides for highly available long running business processing scenarios.
- Reduced software licensing and support costs

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Figure 13: Neuron ESB overall costs up to 7x less than competition

About Neuron ESB

An enterprise service bus (ESB), Neuron ESB is an application integration and web services platform built entirely on Microsoft .NET. Neuron ESB-based integration solutions enable the delivery of real-time, event-driven communication with streamlined and cost-effective implementation, maintenance and support.
For more information and to download a free 30-day evaluation copy of Neuron ESB, visit www.neuronesb.com

If your organization wants to…

- Deploy application and web services integration solutions faster and more efficiently
- Increase productivity without increasing your developer base
- Realize considerable savings on deployment and associated software, hardware, maintenance, upgrade and support costs

…then it's time to explore how Neuron ESB may benefit your organization.

About Neuron ESB Field Services

Neuron ESB Field Services specializes in building solutions for specific customer verticals led by Abhilash Shanmugan who is an Integration veteran. The NFS team has deep experience not only in the Neuron ESB product also in the vertical industries where we put out reference architecture, white papers and solutions that can be used to realize the end goal of quick ROI on our projects. We are also at the forefront of technology trends like mobility and IoT, and overlay these patterns to solve industry challenges that in turn reduce operational costs and increase revenue. Our field services team works collaboratively with the Neuron ESB product team on pre-release versions of the product, helping to shape the product roadmap for our customers. Engage with us to jumpstart your next innovation initiative.

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About the Author

Manav Mittal has over 14 years of consulting and software development experience in Oil & Gas and Utilities industry. He is a result-oriented, techno functional integration specialist, and brings with him broad experience in designing and implementing solutions integrating large business systems for O&G Majors across the value chain (from Upstream to Downstream). He has a degree in Mechanical Engineering and various industry and technical certifications under his belt.

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