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Extending AVEVA™ PI System™ with cloud data integrations

Flint Hills Resources

Kevin Brashears – Senior IT/OT Software Engineer

Tyler Sontag – IT/OT Supervisor

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Agenda

Flint Hills Resources

- Flint Hills Resources (FHR) Background
- FHR Data Pipeline Background
- Modern Cloud Data Integrations
- “Poseidon”

Flint Hills Resources (FHR) Background

A subsidiary of Koch Industries

- FHR Background
 - - 2 refineries
 - - ~4000 miles of pipeline
 - - ~20 terminals
 - - OSIsoft/AVEVA customer for 30+ years
- AVEVA Solutions Deployed
 - - 11 AVEVA PI Server collectives (~7.43MM PI Points)
 - - 11 AVEVA PI Server asset framework instances
 - - 9 AVEVA PI Vision instances
 - - 100+ PI Interfaces & Connectors
 - - 3 AVEVA (Wonderware) Historians
 - - AVEVA Enterprise SCADA (Oasys)



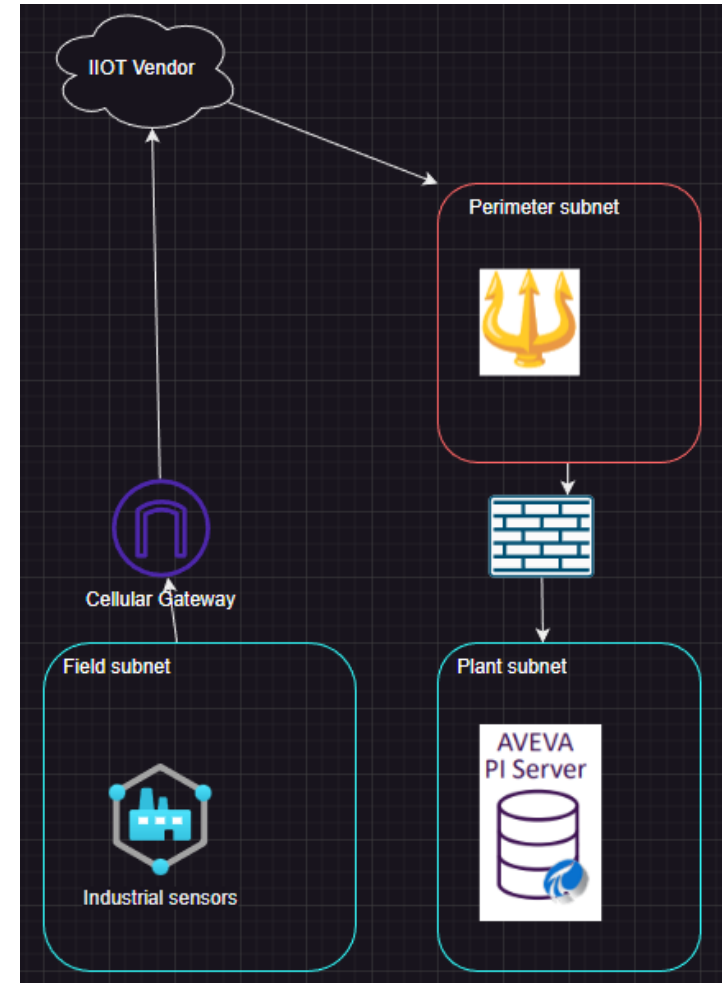
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FHR Data Pipeline Background



What is FHR's Data Pipeline

- Data Pipeline – collection of reliable and repeatable systems for data acquisition, contextualization, and storage
- Primarily focused on data "within the fence line"
- Many vendors adopting cloud first solutions, requiring "hair pinning" the data back to us
- Ingress opportunities can be a pull (interact with vendor endpoint) or a push (vendor send to our endpoint)
- Data egress opportunities mirror these strategies (e.g sending historian data to AI/ML)
- Publicly available data sources: weather, prices, USGS, utilities, etc.



How does FHR think of data ingress and egress?

- Functional requirements for data platform:
 - Contextualization
 - Be able to continue using AVEVA PI Server asset framework structures for analytics (avoid rework)
 - FHR naming standards
 - Scheduling
 - Authorization
 - Data monitoring and quality
- AVEVA products with similar or complementary functionality:
 - AVEVA Data Hub
 - AVEVA Adapters
 - AVEVA Open Message Framework (OMF), a PI Web API
 - PI (USL) Connectors & PI Interfaces

“**Poseidon**” is the tool that handles these constraints and uses the PI Web API to deliver data that flows through FHR’s Data Pipeline



Flint Hills Resources extends data pipeline by integrating cloud data into AVEVA™ PI System™

Challenge

- Integrate valuable cloud-based data sources into company's existing data platform—bringing new information and insight to decision makers.
- Share data with authorized external partners, some of which don't use AVEVA PI System.
- Minimize integration work & continue analytics based on asset framework data structure

Solution

- Use cloud-based data aggregator to feed new data sources into company's existing AVEVA PI System, retaining contextualization and analytics based on PI Server AF data structures.
- Design reusable interfaces for future expansion of data sources.



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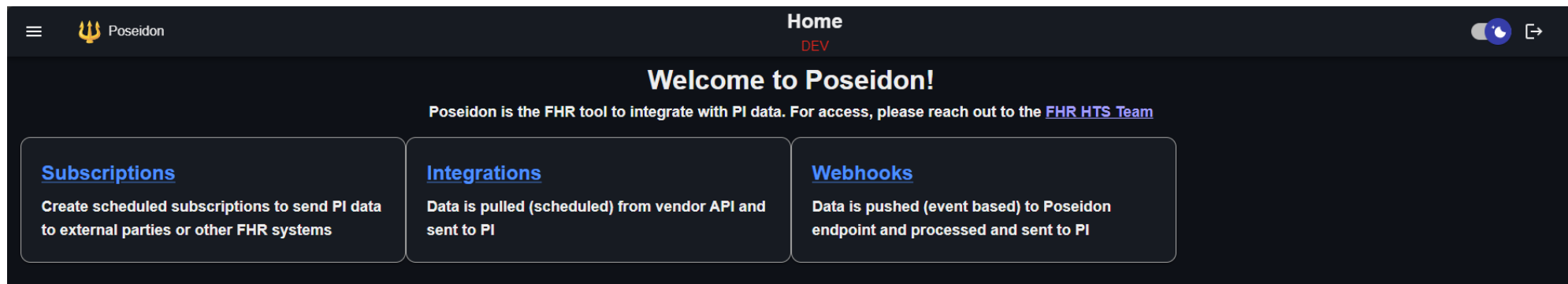
Building FHR's "Poseidon"

AVEVA

Role of Poseidon

A modern cloud data infrastructure

- Extension of our Data Pipeline for cloud-based data
- Utilizes PI Web API to interact with AVEVA PI System
- Modularly built for reusability and configurability
 - Code for ingress/egress is always going to be the same, just different settings (i.e. interpolated vs. recorded, etc.)



The screenshot shows the Poseidon web application interface. At the top left, there is a menu icon and the Poseidon logo. The top right shows the user's profile and a share icon. The main content area features a 'Home' header with a 'DEV' status indicator. Below this is a 'Welcome to Poseidon!' message, followed by a note that Poseidon is the FHR tool for integrating with PI data and a link to the 'FHR HTS Team'. Three main sections are displayed: 'Subscriptions' (for sending PI data to external parties), 'Integrations' (for pulling data from vendor APIs), and 'Webhooks' (for pushing data to Poseidon endpoints).

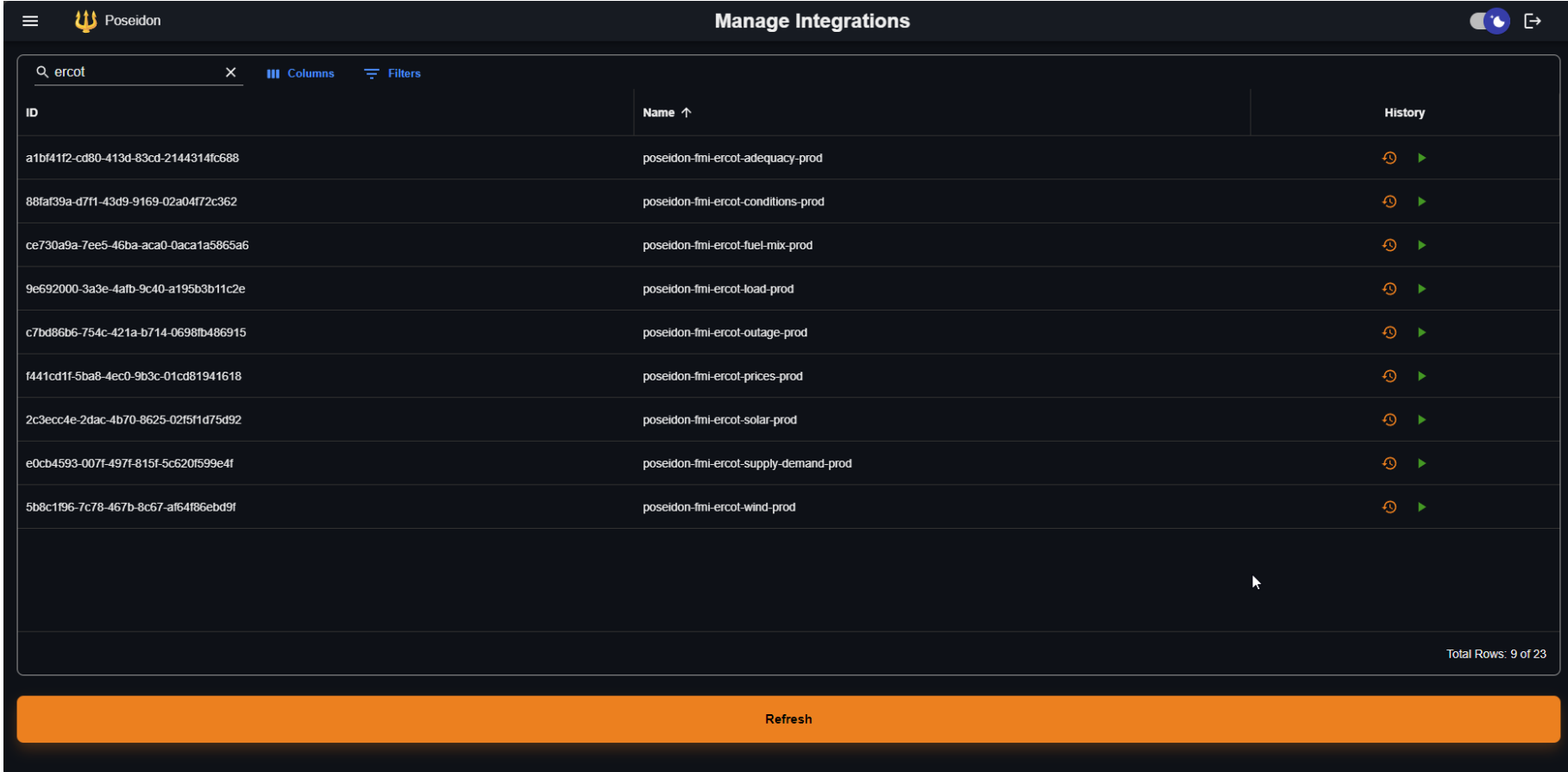
Architecture of Poseidon

Cost efficient infrastructure, easily expandable

- Built on AWS infrastructure:
 - API Gateway & CloudFront for API/front end
 - Lambda for backend
 - DynamoDB for backend database storage
 - Simple Queue Service (SQS) for queuing and retry logic
 - S3 bucket for data storage
- Egress – LMIs (Last mile integrations) for subscription flows (different modules)
- Ingress – FMIs (First mile integrations) for integration flows
- Ingress – Webhooks (HTTP endpoint) for event based integration flows

Data ingress/integrations

- Inverse of data subscriptions
- Run on schedule determined by business
- When off-the-shelf interface is not available, can write code to reach out to API endpoints and contextualize that data
- Reusable process pulls data into AVEVA PI Server



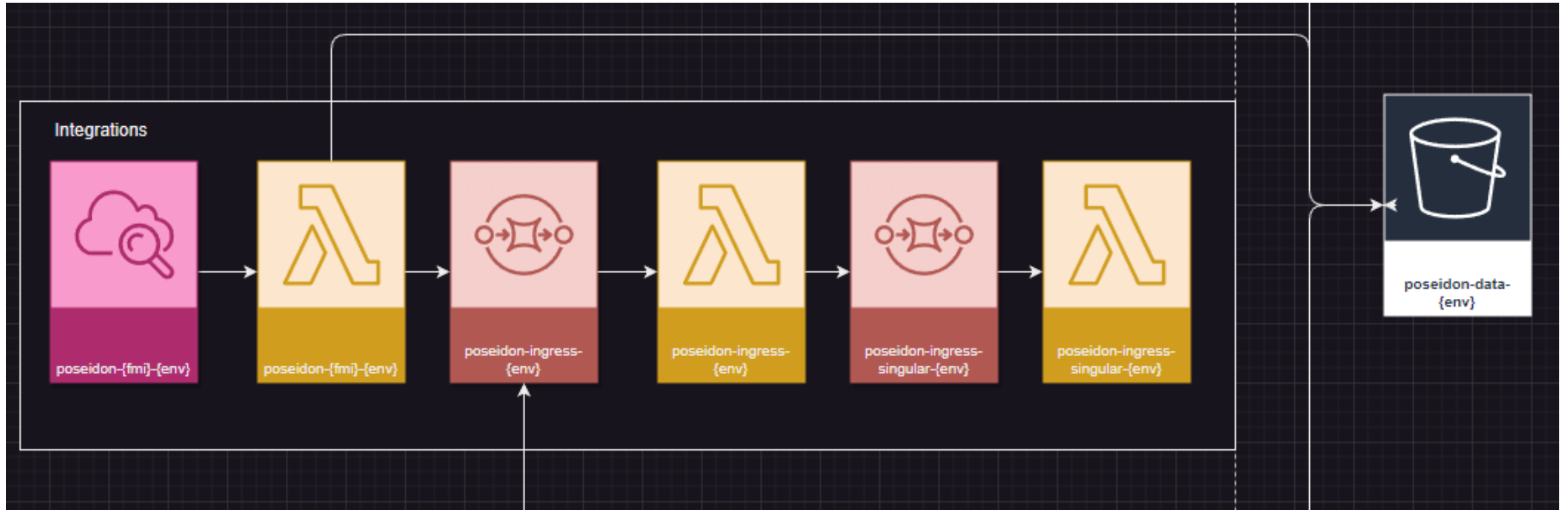
The screenshot shows the 'Manage Integrations' interface in the Poseidon application. The search bar contains 'ercot'. The table lists various integrations with their IDs, names, and history status. A 'Refresh' button is located at the bottom of the interface.

ID	Name ↑	History
a1bf41f2-cd80-413d-83cd-2144314f6688	poseidon-fmi-ercot-adequacy-prod	
88faf39a-d7f1-43d9-9169-02a04f72c362	poseidon-fmi-ercot-conditions-prod	
ce730a9a-7ee5-46ba-aca0-0aca1a5865a6	poseidon-fmi-ercot-fuel-mix-prod	
9e692000-3a3e-4afb-9c40-a195b3b11c2e	poseidon-fmi-ercot-load-prod	
c7bd86b6-754c-421a-b714-0698fb486915	poseidon-fmi-ercot-outage-prod	
f441cd1f-5ba8-4ec0-9b3c-01cd81941618	poseidon-fmi-ercot-prices-prod	
2c3ecc4e-2dac-4b70-8625-02f5f1d75d92	poseidon-fmi-ercot-solar-prod	
e0cb4593-007f-497f-815f-5c620f599e4f	poseidon-fmi-ercot-supply-demand-prod	
5b8c1f96-7c78-467b-8c67-af64f86ebd9f	poseidon-fmi-ercot-wind-prod	

Total Rows: 9 of 23

Refresh

Integrations data flow



Data ingress/integration examples

- Weather data (publicly available)
- Weather data (on site weather transmitters)
- Energy pricing data (publicly available)
- Sample testing vendor
- Natural gas pricing data (publicly available)
- ...and more!

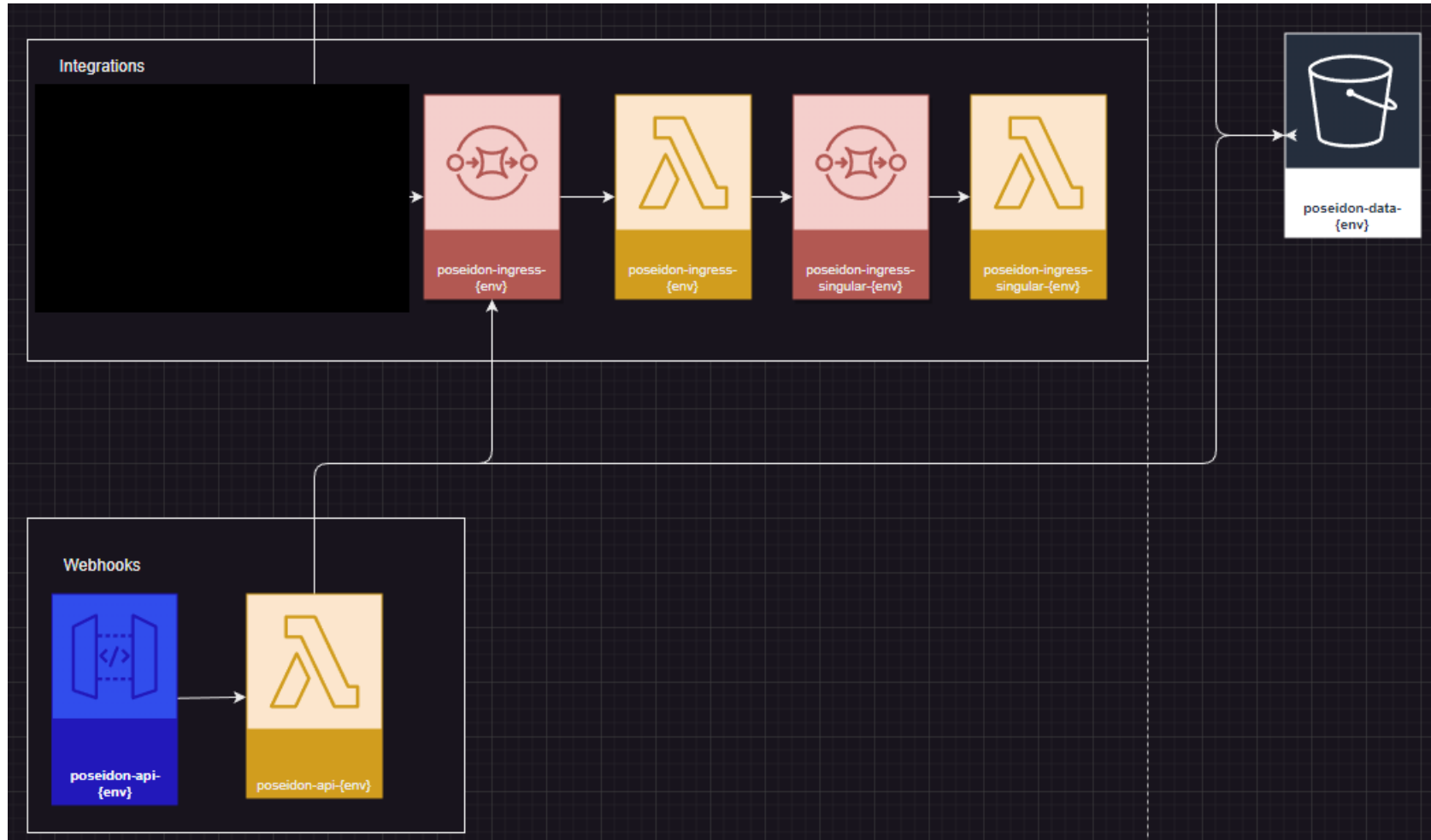
Event-based ingress/integrations (webhooks)

- Pushed instead of pulled
- Specific code to translate the webhook and contextualize that data
- Sends to reusable process to ingest into PI
- Event based

Practical example: Valve position sensors

- LoRaWAN sensors at plant that measure valve positions
- Data is sent to vendor's cloud platform
- Can view data on their dashboards
- Need to get that data back, they POST to our API

Webhooks data flow



Data egress via subscriptions

- Create subscriptions to send PI data
 - Externally to vendors for advanced analytics
 - Internally to other FHR applications
- Specify target, AF path, frequency, and extraction type
- Optionally filter by categories/templates
 - Provides performance enhancements over PI Web APIs
- Validations occur to ensure path/categories/templates are all valid

Edit Subscription

Name * Enabled

Please give a friendly name for this subscription

Target *

Select which endpoint to send data to

Dataset Name * Site Name *

Name of the dataset in the datalake Name of the site in the datalake

AF Path * Frequency *

Valid AF path to the data you want to send Select the frequency at which to send the data

extractionType *

How to extract the data

Start Time (minutes)

Time, in minutes, to start recorded or interpolated extracts

Retrieve Element Children Retrieve Root Element

Element Category

Optional Element category to filter children with. Retrieve Element Children must be true for this to be used

Element Template

Optional Element template to filter children with. Retrieve Element Children must be true for this to be used

Attribute Category

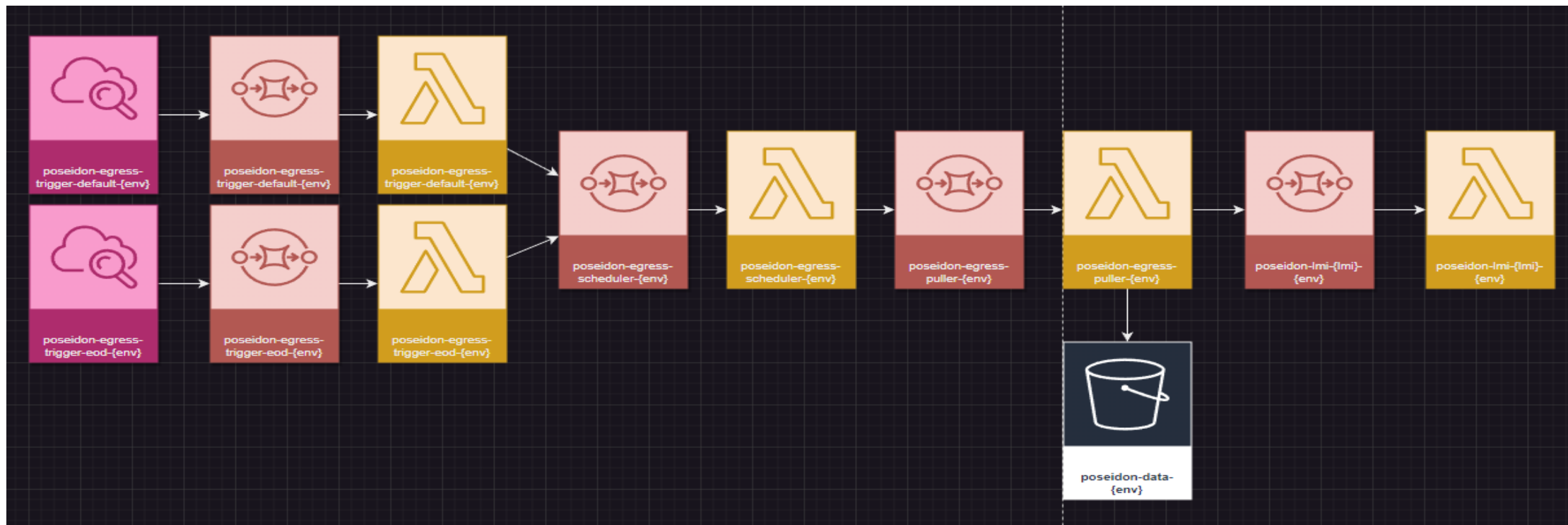
Optional Attribute category to filter attributes with

Data egress/subscription examples

- FHR's internal data lake
- FHR's internal work order platform
- Email with .CSV attachment
- Environmental reporting vendor
- Coker drum analytics vendor
- Water quality analytics vendor
- Python calcs (more later!)
- ...and more!

Data subscription flow

- AWS Schedule runs every minute (special EOD logic) to determines which subscriptions need to run
- Data is extracted (puller) and dropped into S3 bucket, the LMI handles the special logic for the specific endpoint



Performing calculations outside asset framework

- LMIs don't always have to be sending data externally
- Some calculations go beyond what is possible with asset framework analytics
- Python can do these calcs quite easily (i.e. array calcs, linear regressions, etc.)
- Business sponsors helped write python calcs
- Poseidon handles these on a scheduled basis no different than built-in analyses

Target *

isaac

Select which endpoint to send data to

Isaac Calculation *

sum-product

distillation-cut-point

sum-product

Platform transparency strengthens security

- Surfaced logs to the front end to be better self serviced by business users and not always IT

ERCOT Forecasts Data					
Actual Timestamp ↓	Processed Timestamp	Step	Successful?	Message	Correlation ID
10/9/2023, 11:01:47 AM	10/9/2023, 11:00:00 AM	egress-delivery	✓	Completed egress delivery to datalake	c5874d48-d33f-4807-9c62-aa7b23d19967
10/9/2023, 11:01:46 AM	10/9/2023, 11:00:00 AM	egress-delivery	✓	Starting egress delivery to datalake	c5874d48-d33f-4807-9c62-aa7b23d19967
10/9/2023, 11:01:46 AM	10/9/2023, 11:00:00 AM	data-extraction	✓	Completed PI data extraction	c5874d48-d33f-4807-9c62-aa7b23d19967
10/9/2023, 11:01:17 AM	10/9/2023, 11:00:00 AM	data-extraction	✓	Starting PI data extraction	c5874d48-d33f-4807-9c62-aa7b23d19967
10/9/2023, 10:02:38 AM	10/9/2023, 10:00:00 AM	egress-delivery	✓	Completed egress delivery to datalake	611caef-24a9-449c-a141-ddfca88dac63
10/9/2023, 10:02:37 AM	10/9/2023, 10:00:00 AM	egress-delivery	✓	Starting egress delivery to datalake	611caef-24a9-449c-a141-ddfca88dac63
10/9/2023, 10:02:37 AM	10/9/2023, 10:00:00 AM	data-extraction	✓	Completed PI data extraction	611caef-24a9-449c-a141-ddfca88dac63
10/9/2023, 10:01:22 AM	10/9/2023, 10:00:00 AM	data-extraction	✓	Starting PI data extraction	611caef-24a9-449c-a141-ddfca88dac63
10/9/2023, 9:01:59 AM	10/9/2023, 9:00:00 AM	egress-delivery	✓	Completed egress delivery to datalake	e276eb92-5978-4aec-80c4-63547ee54f14
10/9/2023, 9:01:57 AM	10/9/2023, 9:00:00 AM	egress-delivery	✓	Starting egress delivery to datalake	e276eb92-5978-4aec-80c4-63547ee54f14
10/9/2023, 9:01:52 AM	10/9/2023, 9:00:00 AM	data-extraction	✓	Completed PI data extraction	e276eb92-5978-4aec-80c4-63547ee54f14

Total Rows: 674

Refresh

Close History

Potential Poseidon enhancement

- Use AVEVA PI Vision to help admins migrate displays between environments:
 - When an environment doesn't support scheduled syncs
 - When you need to restore displays from a SQL backup
- With AVEVA PI Vision 2022 release, we can automate:
 - Sync of displays between environments (changing AF servers / PI servers), with persistent folder structures
 - Back-up of displays on a regular cadence (daily)
 - Restoration of individual displays

New Restoration

PI Vision Server *
DEV
Select which PI Vision Server to restore on

Display Path *
/Home/Sinusoid.json
Select which PI Vision display to restore

Version *
2023-10-03T18:21:45.000Z
Select which version to restore to

Cancel Create

Summary

- Data infrastructure must easily integrate multi-vendor data and deliver data to multiple endpoints (tools, analysis platforms and business applications) -- particularly those that are **cloud-based**. Examples below.
- With reusable processes, new integrations & endpoints can be stood up in hours instead of days.
- Data infrastructure must handle the required context, standards, and synch scheduling that business desires.



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- Design reusable interfaces for future expansion of data sources.

Results

- **Support for these interfaces is way easier than one off scripts.**
- **All integrations in one place, making support easier.**
- **Leverageable platform for other Koch companies to use.**
- **New integrations use reusable code and can be created in hours instead of days.**





Kevin Brashears

Senior IT/OT Software Engineer

- Flint Hills Resources
- Kevin.Brashears@fhr.com



Tyler Sontag

IT/OT Supervisor

- Flint Hills Resources
- Tyler.Sontag@fhr.com

Questions?

Please wait for the microphone.
State your name and company.



Please remember to...

Navigate to this session in the mobile app to complete the survey.



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