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Improving AVEVA™ PI System™ data reliability: A multi-layered approach

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What are we talking about here?

Defining some terms and setting the scope

- Context: time-series data in AVEVA PI System

- "Data reliability," "data quality," or "data integrity"?
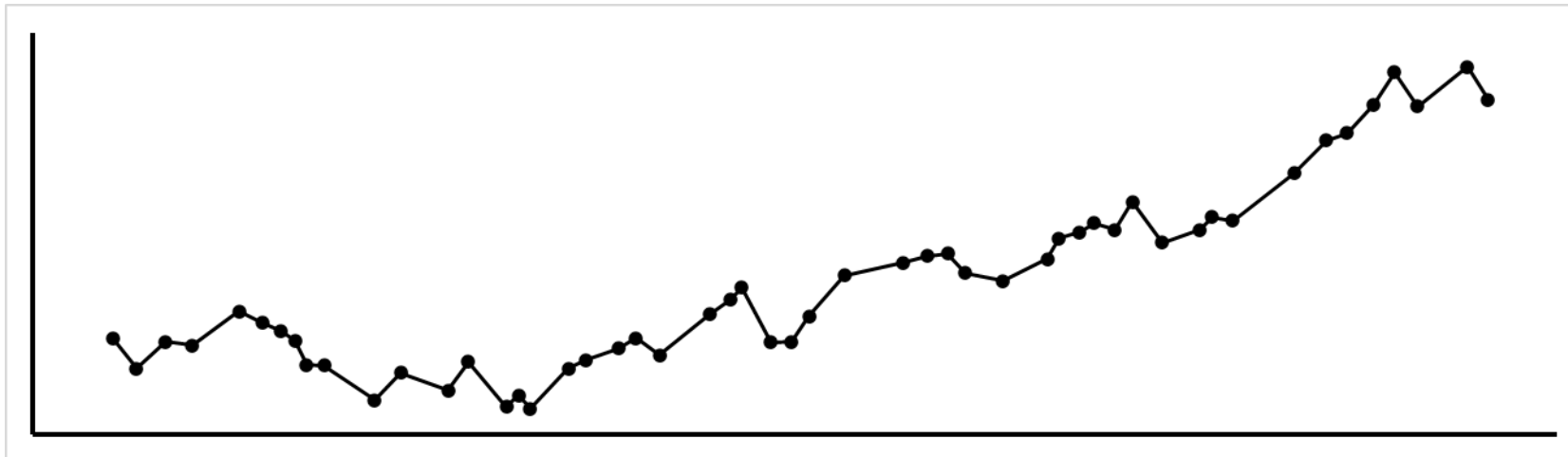
| **Accuracy** Is the data free from errors or misinformation? | **Completeness** Did we get all the data? | **Timeliness** Did the data arrive on time? |

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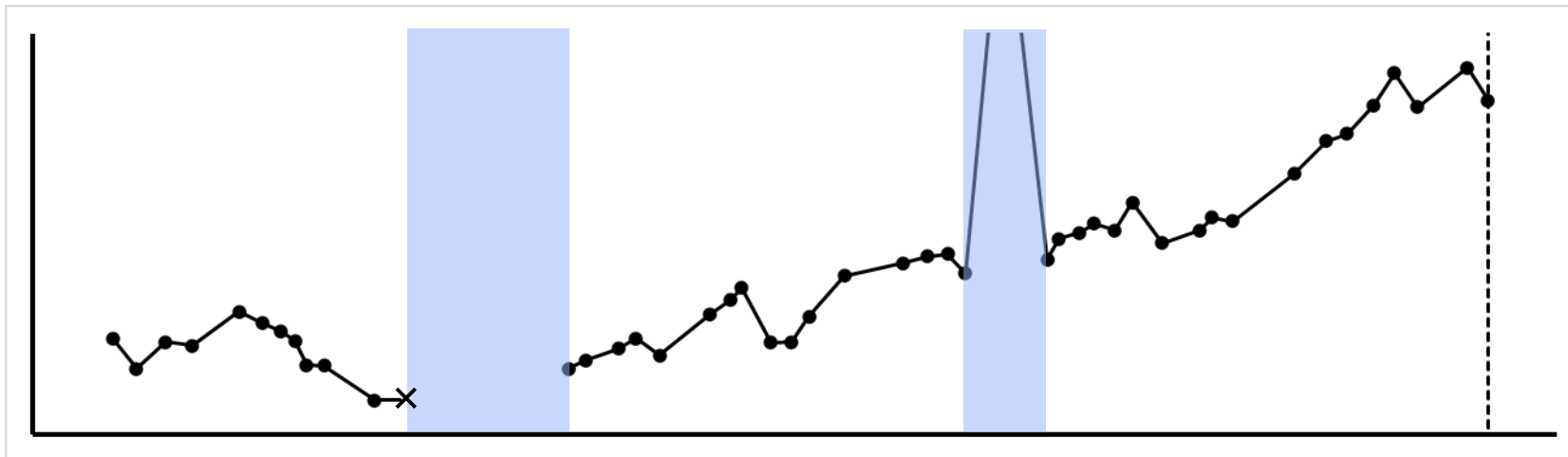
Accuracy	**Completeness**	**Timeliness**
Are there bad values or out of range values?	Did we get all the data?	Did the data arrive on time?

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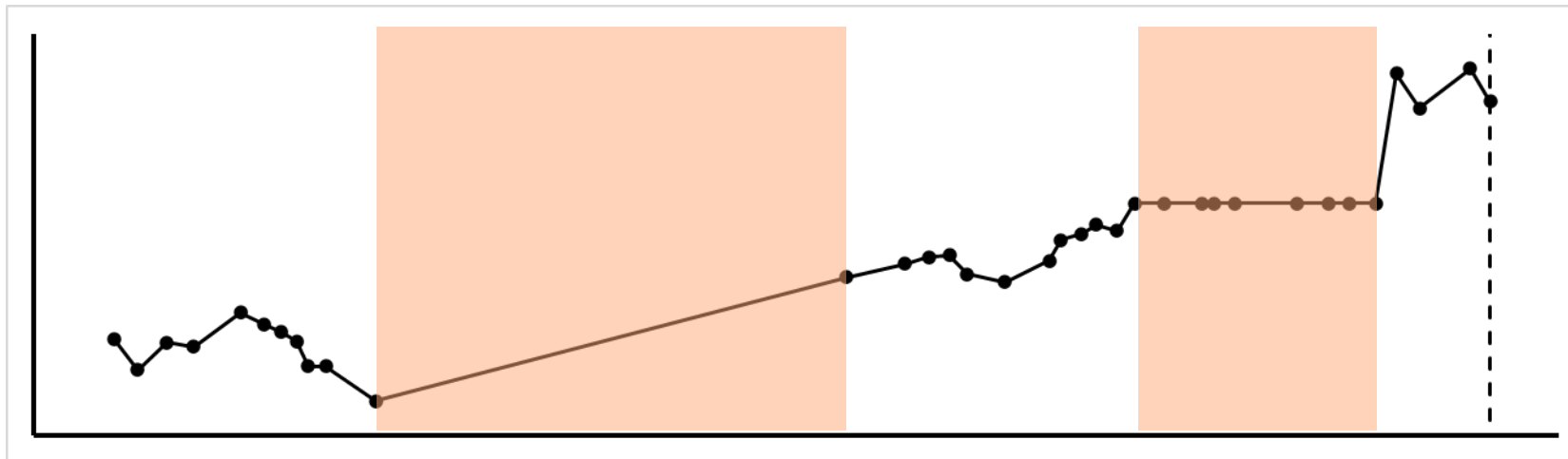- "Data reliability," "data quality," or "data integrity"?

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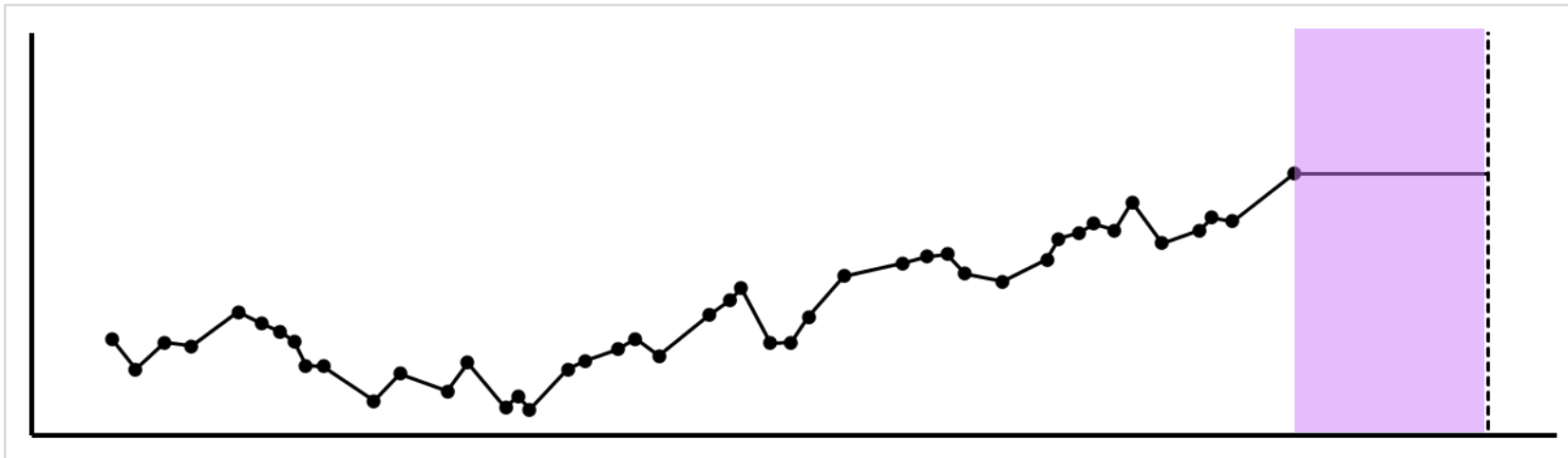
Accuracy Are there bad values or out of range values?	**Completeness** Are there data gaps or flatlines?	**Timeliness** Is the data stale?

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Why do we care about this topic?

Testimonials from AVEVA PI System administrators and business owners

- AVEVA PI System data feeds rollups for our corporate dashboards
- The data needs to be accurate

- AVEVA PI System is critical to monitoring our operations
- Users complain loudly when it's stale or bad

- Our modeling applications are sensitive to bad quality data
- We need to keep AVEVA PI System data as clean as possible.

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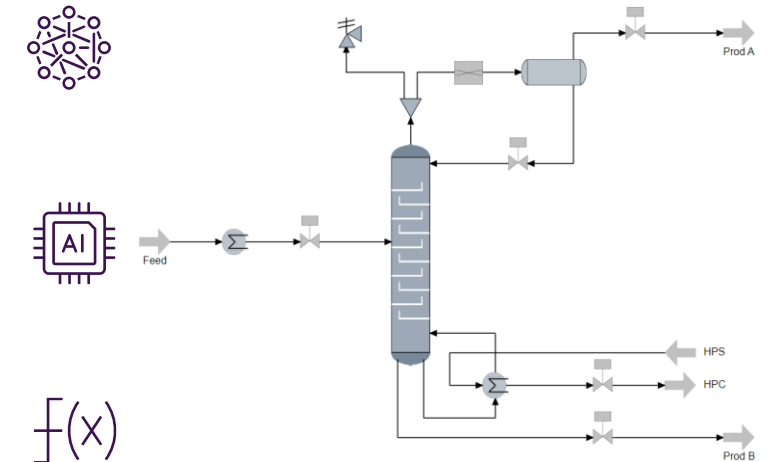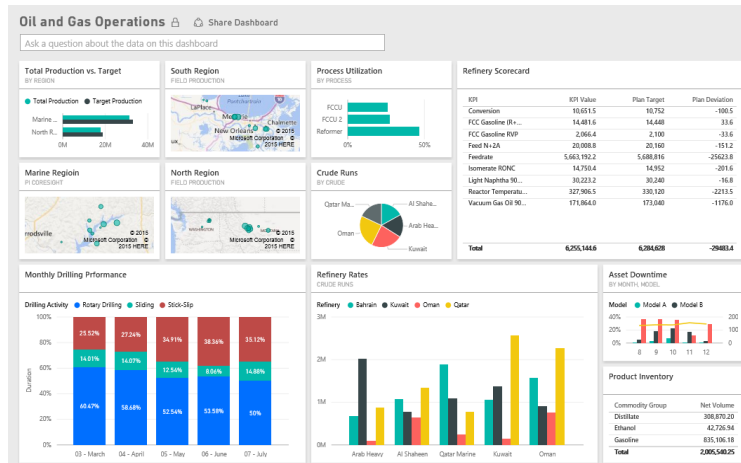
Goals & approaches

- Main goals:
  - **Protect against issues that negatively impact data reliability**
  - **Identify and report issues as soon a possible**
  - ~~Not concerned with data cleansing or profiling~~

- Approaches
  - Governance and change management
  - High availability architectures
  - System monitoring
  - Monitoring of individual "tag health"

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Data governance

Data quality and governance

Process and governance approaches

- Document and follow processes for changes to source systems and AVEVA PI System.

- Communication and collaboration are key.

- Data quality & governance - best practices (PI World 2019 San Francisco)

https://resources.osisoft.com/presentations/data-quality-and-governance---best-practices/

High availability (HA) architecture

High availability

PI Interface Failover Pair

PI Data Archive Collective

Data Source

Identical data

Primary PI Interface Node

Backup PI Interface Node

Buffered identical data

Backup buffered identical data

Primary PI Data Archive Server

Secondary PI Data Archive Server

Metadata synchronization

Archived, compressed data
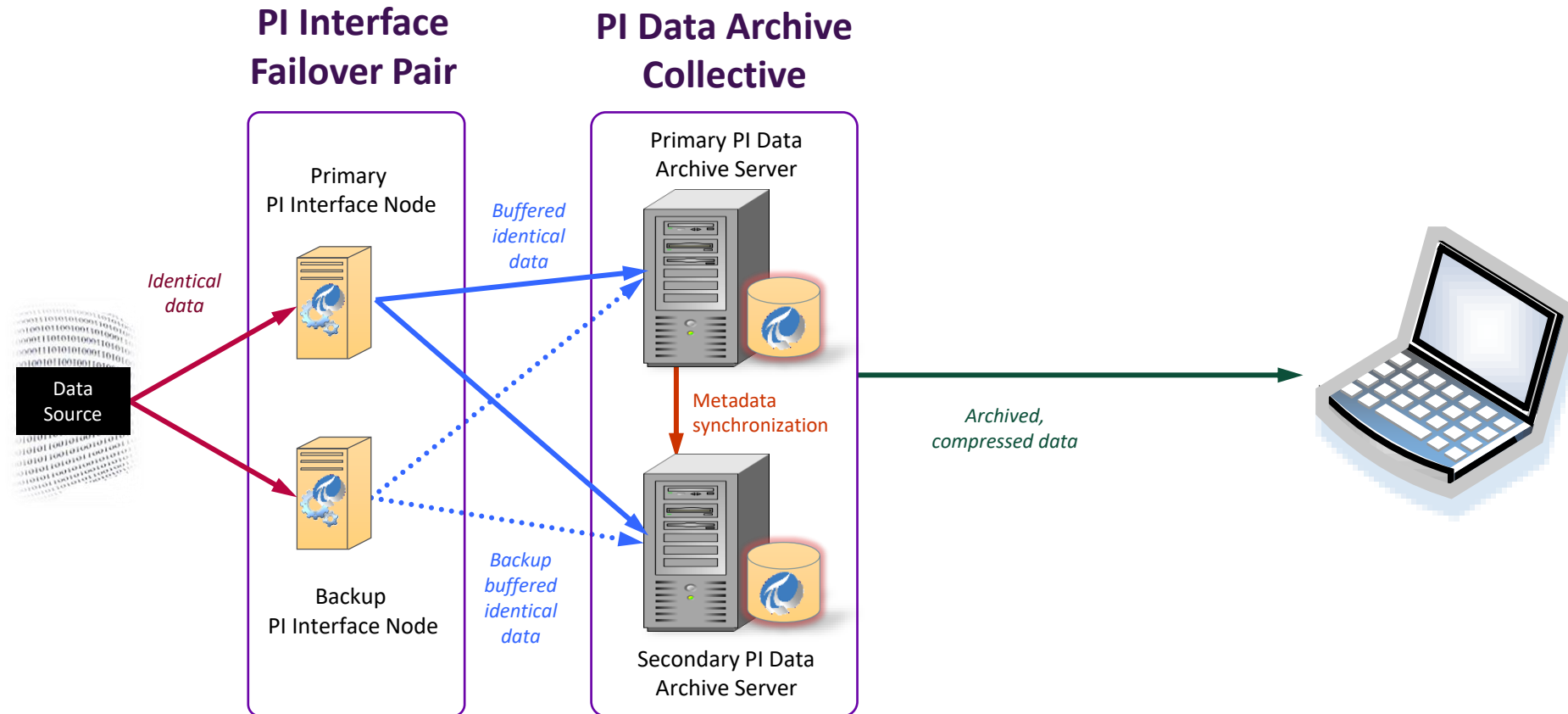
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AVEVA adapter failover: On-premises

Client-side failover

Process plants & on-prem assets

Data source

AVEVA adapters

Failover heath

Failover service

Failover heath

AVEVA adapters

Primary

Secondary

AVEVA™ PI Server

Failover modes:
- Hot
- Warm
- Cold

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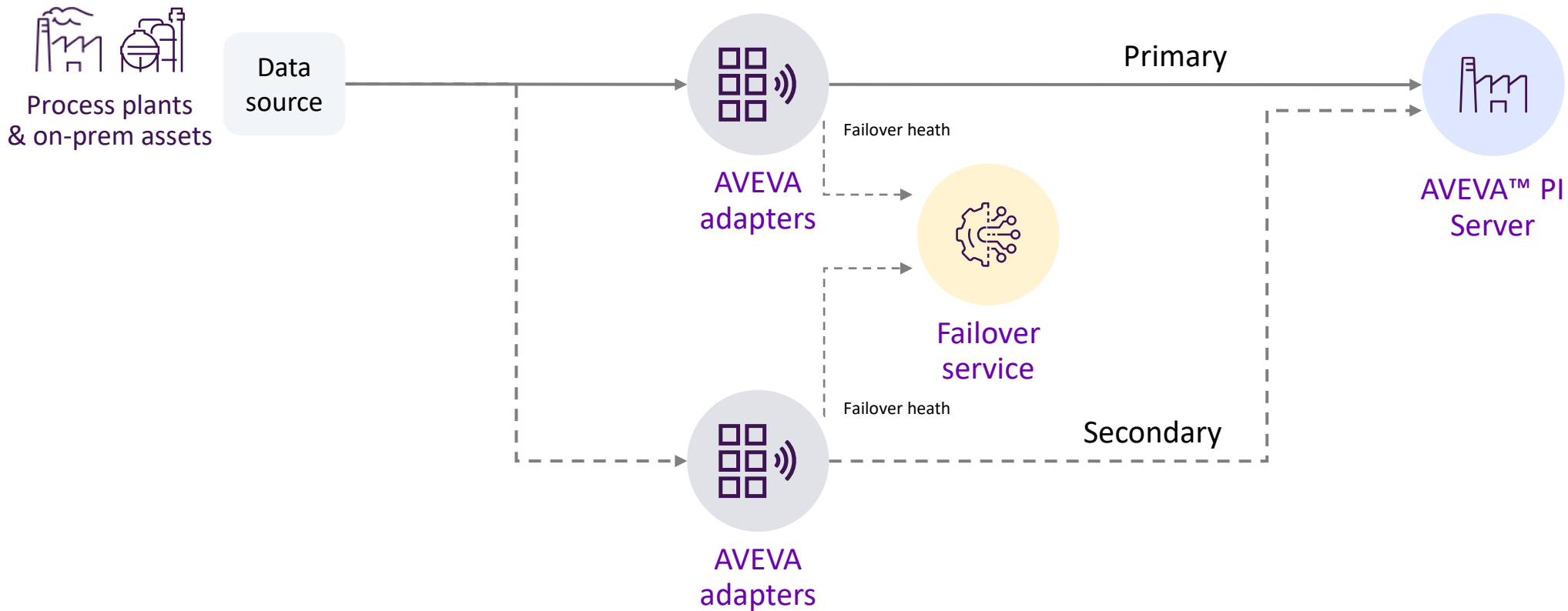
AVEVA adapter failover: Cloud

Client-side failover

Remote assets, sensors, & IIoT devices

Data Source

AVEVA Adapters

AVEVA Adapters

Primary

Failover heath

Secondary

AVEVA Connect
AVEVA Data Hub Failover Endpoint
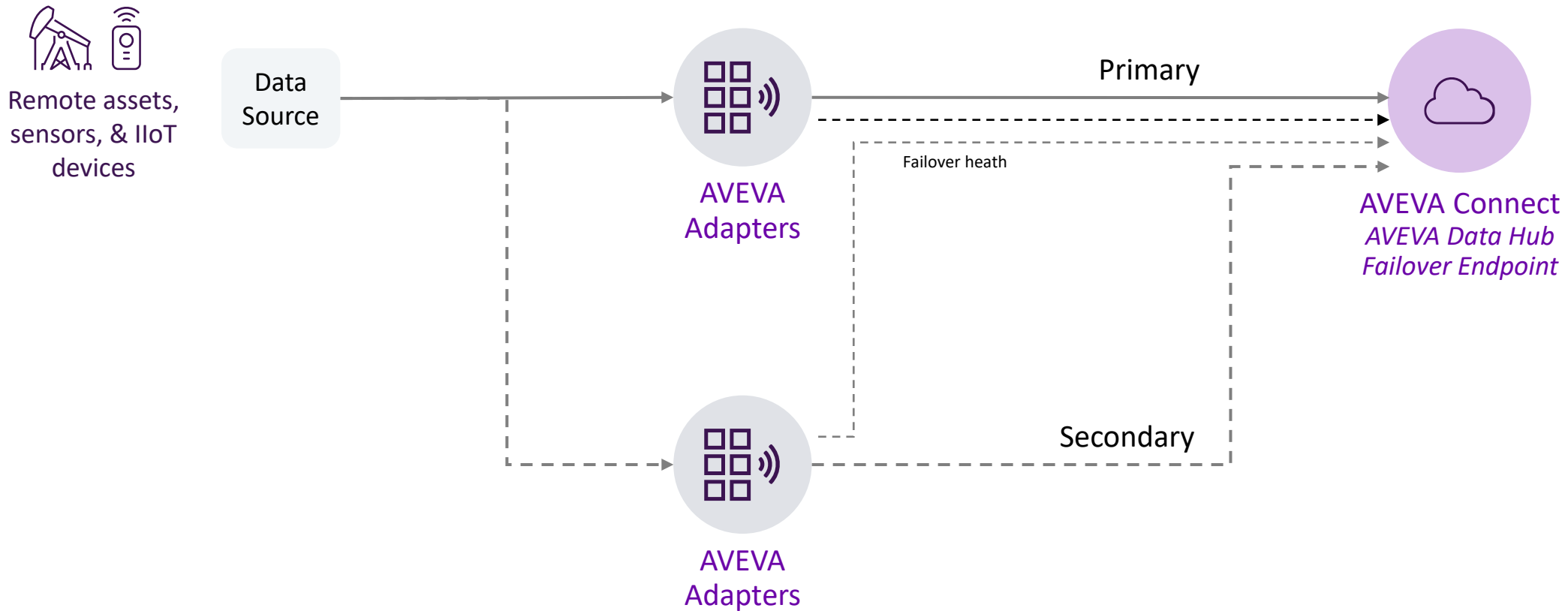
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AVEVA adapter failover

Client-side and server-side failover for AVEVA PI Server and AVEVA™ Data Hub

Supported failover endpoints

Data source — Primary → **AVEVA adapters**

Data source — Secondary → **AVEVA adapters**

Client failover service

Primary / Secondary

AVEVA PI Server

or

AVEVA Data Hub
via AVEVA™ Connect

Client and server failover modes:
- Hot
- Warm
- Cold

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System monitoring

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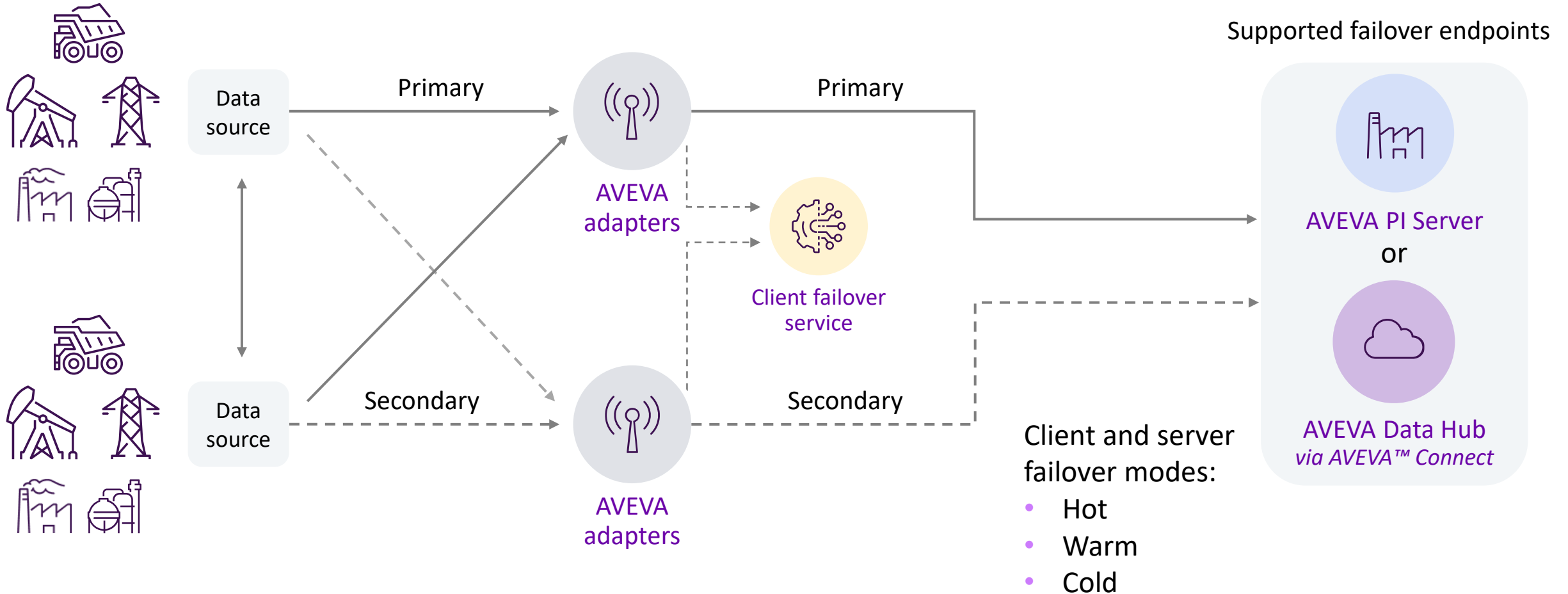
Problems and challenges

Hundreds of instances of connectors and interfaces can require around-the-clock observation

Tracking and monitoring

Quality degradation

Limited insight and visualization

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Manage software deployments at scale with AVEVA™ Edge Management

AVEVA Connect

Data Hub

Edge Management

AVEVA PI Server

AVEVA & Third-party applications

AVEVA Edge Management

Legend:
- AVEVA Adapter module
- Edge Data Store module
- Edge Management components
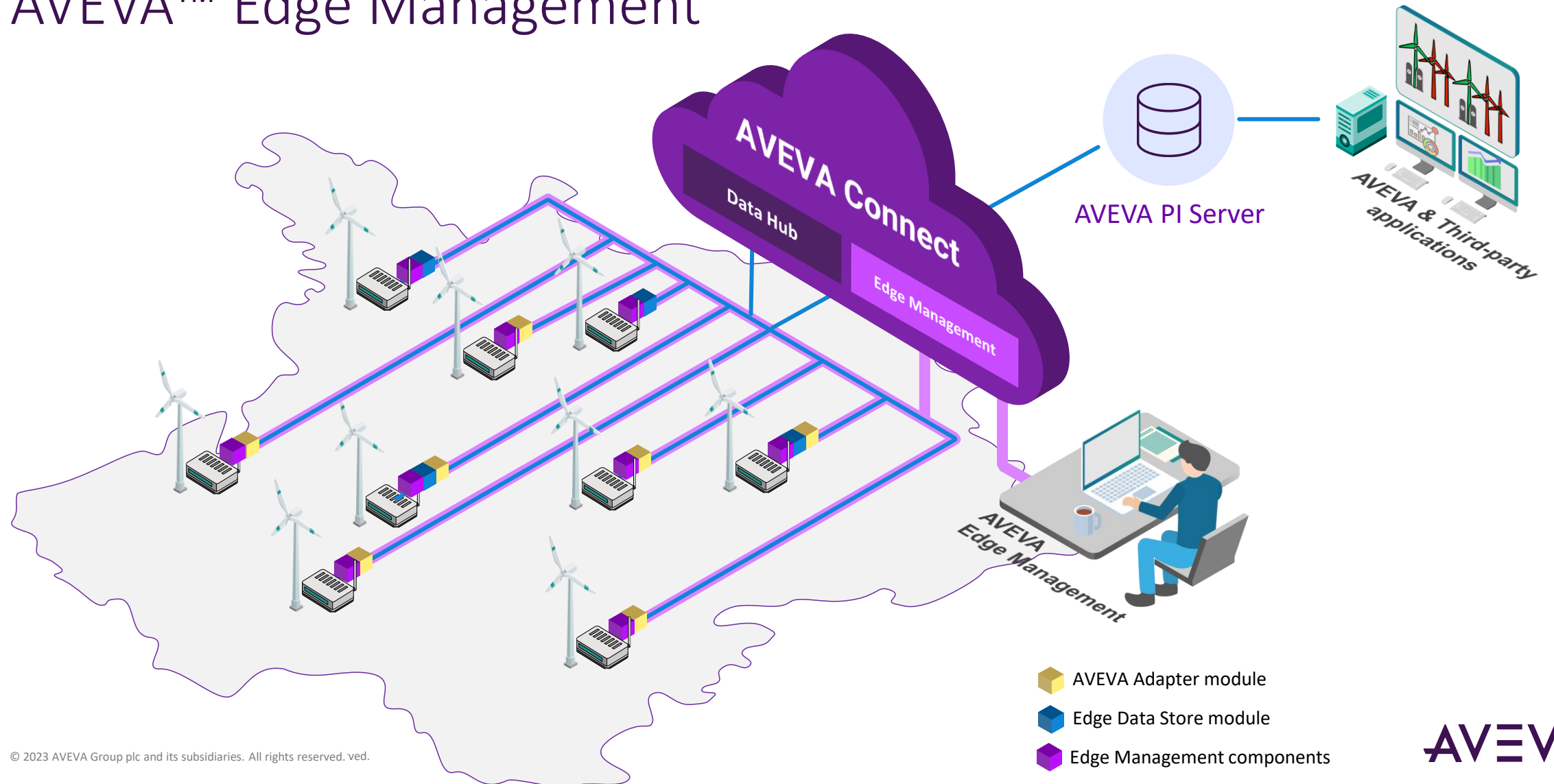
Solution

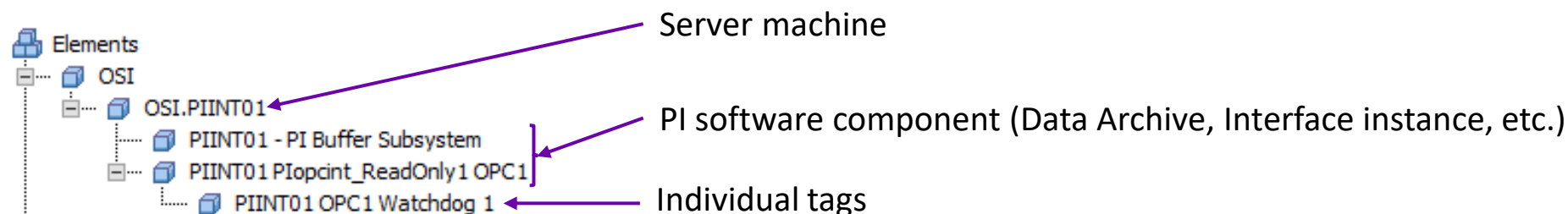## With AVEVA Edge Management, we can now monitor

System monitoring with AF & asset analytics: PSM

AVEVA PI System status monitoring from AVEVA PI System technical adoption services

- The AVEVA PI System monitoring service offering includes AF templates to help with monitoring at several levels

- Leverages data from Perfmon, Ping, & TCP Response Interfaces

- Example:

  Elements
  └── OSI
      └── OSI.PIINT01 ←————————————— Server machine
          ├── PIINT01 - PI Buffer Subsystem
          └── PIINT01 PIopcint_ReadOnly1 OPC1 ←——— PI software component (Data Archive, Interface instance, etc.)
              └── PIINT01 OPC1 Watchdog 1 ←———————— Individual tags

- Server and component monitoring help minimize impact of wide outages (many tags).
  - Examples: poor service health, low I/O Rate, queuing data, and network issues

- Watchdog tags: key tags that can help identify data source or interface issues
  - Stale or flatline data
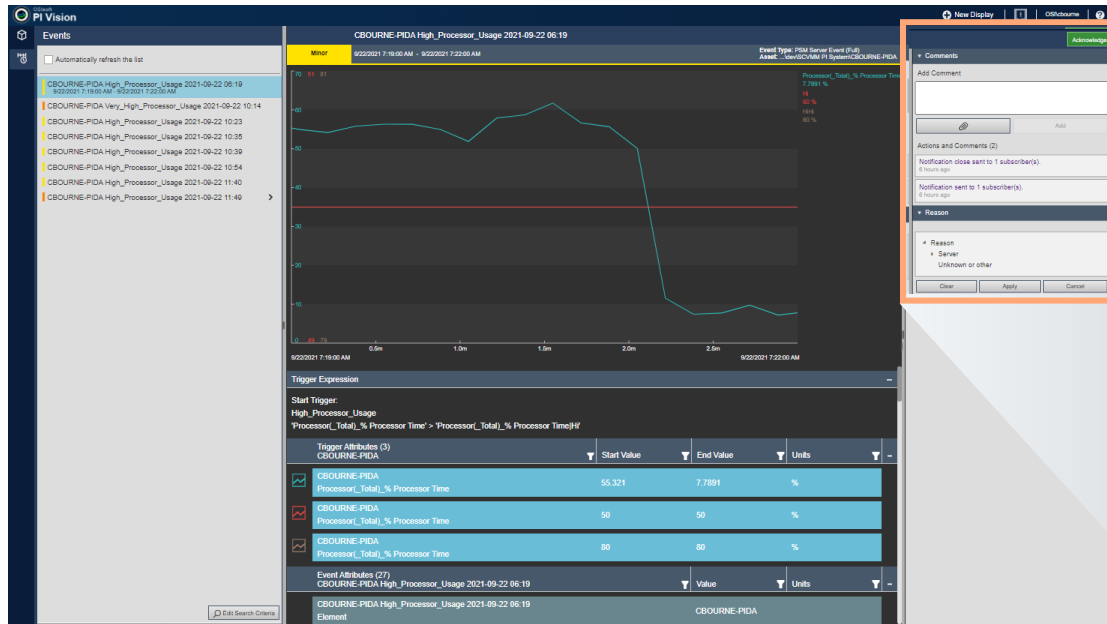
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PSM: Identify & alert

Event frames

Add Context

- Reason attribute
- Annotations
- Acknowledgement

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PSM: Identify & alert

Notifications

PSM: Identify & alert

PSM: Identify, alert, visualize

AVEVA™ PI Vision™

New Display

PSM Interfaces & Buffering

Filtered Event Table | Servers (Overview) | Server (Detail) | Interface & Buffer | Data Archive | AF/Analytics/Notifications | Analysis Service

Interface Information (Click machine name for interface event list)

Interfaces Stopped or Not Communicating w/ PI Server

Machine	Interface Name	Point Source	ID	Point Cnt	Device Status	PI Status	❤	UpTime	IO Rate (evt/s)
PIINT02	PI opcint_ReadOnly1	OPC1	1	71.499	Good	Down	71	0.0 d	71.499 event/s

Interfaces Stopped or Device Status not Good

Machine	Interface Name	Point Source	ID	Point Cnt	Device Status	PI Status	❤	UpTime	IO Rate (evt/s)
PIINT01	PI-opcint_ReadOnly1	OPC1	1	71.499	Device(s) in error	Communicating	71	0.0 d	71.499 event/s

Interfaces Statuses Good

Machine	Interface Name	Point Source	ID	Point Cnt	Device Status	PI Status	❤	UpTime	IO Rate (evt/s)
PIINT01	PI opcint_ReadOnly2	PIINT01_OPC	1	71.499	Good	Communicating	71	0.0 d	71.499 event/s
PISRV01	PI-PITCPResp1	PISRV01_TCPRESP	1	71.499	Good	Communicating	71	0.0 d	71.499 event/s

Buffer Subsystem Information (Click machine name for buffer event list)

Unhealthy Buffer Subsystems

Machine	Health	Capacity	Queued Events	Sessions Offline	Compression Ratio	Event Send Rates Total	OOO
PIINT01	Warning	71.5 d	71	0	11.2 :1	71.5	71.5
PIINT02	Critical	0.0 d	5.1642E+06	0	3 :1	71.5	71.5

Healthy Buffer Subsystems

Machine	Health	Capacity	Queued Events	Sessions Offline	Compression Ratio	Event Send Rates Total	OOO
PIAF01	OK	71.5 d	71	0	26.2 :1	71.5	71.5
PISRV01	OK	71.5 d	71	0	15.8 :1	71.5	71.5

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Tag-level monitoring

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Monitoring tags with AF & asset analytics

- Extension of the PSM watchdog tag methodology

- Typically used for a subset of critical tags

- Scalability considerations:
  - Load on PI Analysis Service
  - Follow Asset Analytics Best Practices for better scaling.
  - Determine practicality of Notifications and design accordingly.

- Published customer examples:
  - Monitoring Data Quality with Asset Analytics (PW2018)
  - Better Data Quality for Better Data Science with the PI System (PW2018)

Name	Expression
vWatchPeriodStart	'*'- Convert('Watch Period',"s")//Convert watch period to seconds & subtract from current time.
vBadChk	If BadVal('Watchdog Tag') Then 1 //Bad Else 0 //Good
vStaleChk	If PrevEvent('Watchdog Tag','*') < vWatchPeriodStart Then 1 //Stale Else 0 //Fresh
vFlatLineChk	If vStaleChk = 1 Or vBadChk = 1 Then 0 //Flatline test = True for stale or bad tags even values aren't repeating Else If NumOfChanges('Watchdog Tag',vWatchPeriodStart,'*') = 0 /*Count changes in watch period. Values from System digital set do not get counted by NumOfChanges*/ Then 1 //Flatline Else 0 //Updating
vOutOfRngChk	If 'Watchdog Tag' < 'Watchdog Tag|Minimum' Then 1 //Under range Else If 'Watchdog Tag' > 'Watchdog Tag|Maximum' Then 2 //Over range Else 0 //In range

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Tag monitoring: Bulk reporting & analysis methodology

Low frequency, periodic queries of many tags

Output lists of tags with relevant data/context

Store and distribute output to AVEVA PI System admins/analysts

Consume lists with reporting/visualization tools

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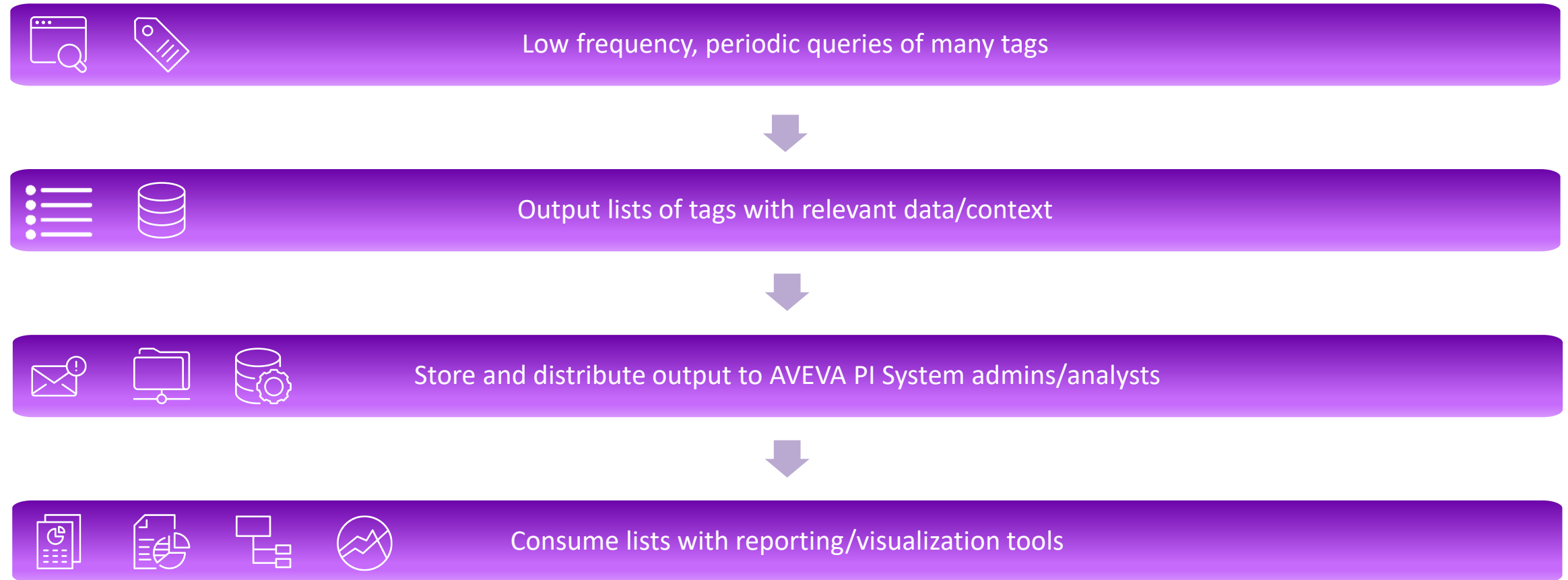
Bulk method: The simplest approach

Stale and bad points plug-in in PI SMT

- Run manually by system admin

- Output to CSV file

- Consume CSV with Excel

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Bulk method: A more automated approach

Run script(s) on a schedule using AVEVA PI System developer technologies

Low frequency, periodic queries of many tags

Developer technologies

- Most typical: PI AF SDK
  - .NET app
  - Called from Powershell

- Older: piconfig (.bat files)

- Other possibilities:
  - Powershell Tools for the PI System
  - (sqlcmd or SQL Server) + PI SQL linked server

Scheduling options

- Windows Task Scheduler

- Other 3rd party tools

- SQL Server Agent (If using SQL Server)

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Bulk method: A more automated approach

Output tag list(s)

Low frequency, periodic queries of many tags

Output lists of tags with relevant data/context

Example output options

- CSV files
- SQL tables
- PI tags for summary values
  - Example: stale tag count

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Bulk method: A more automated approach

Store and distribute output to AVEVA PI System admins and/or analysts

Low frequency, periodic queries of many tags

Output lists of tags with relevant data/context

Store and distribute output
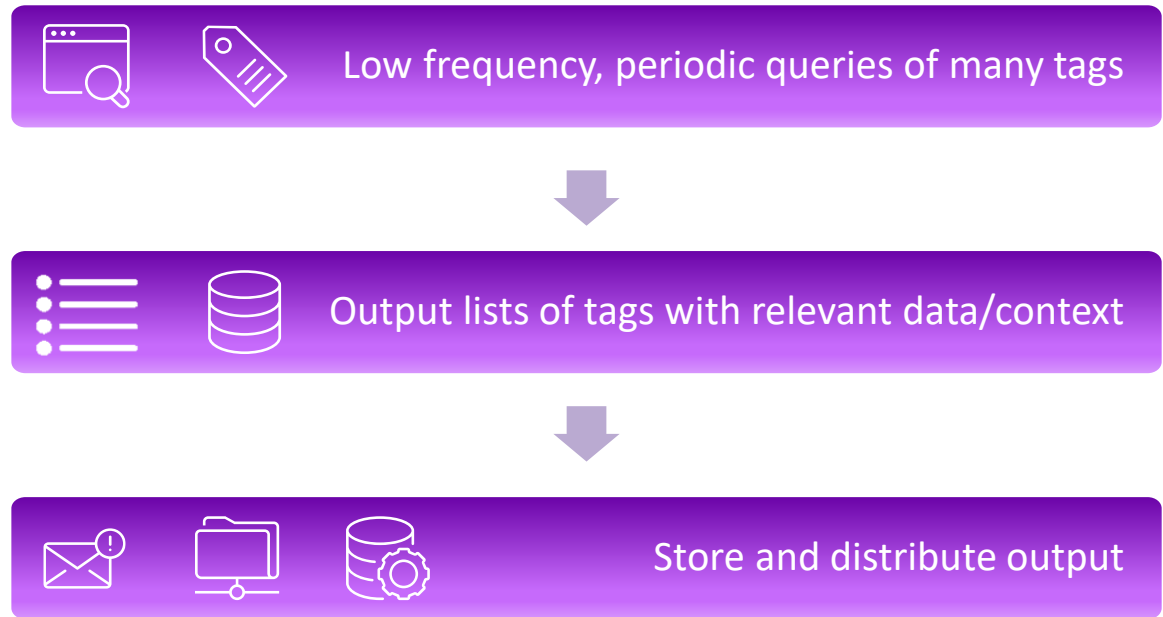
Example distribution options

- Share folder

- Notifications attachment or link

- SQL table

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Bulk method: A more automated approach

Visualize and analyze the data

Low frequency, periodic queries of many tags

Output lists of tags with relevant data/context

Store and distribute output

Reporting/visualization tools
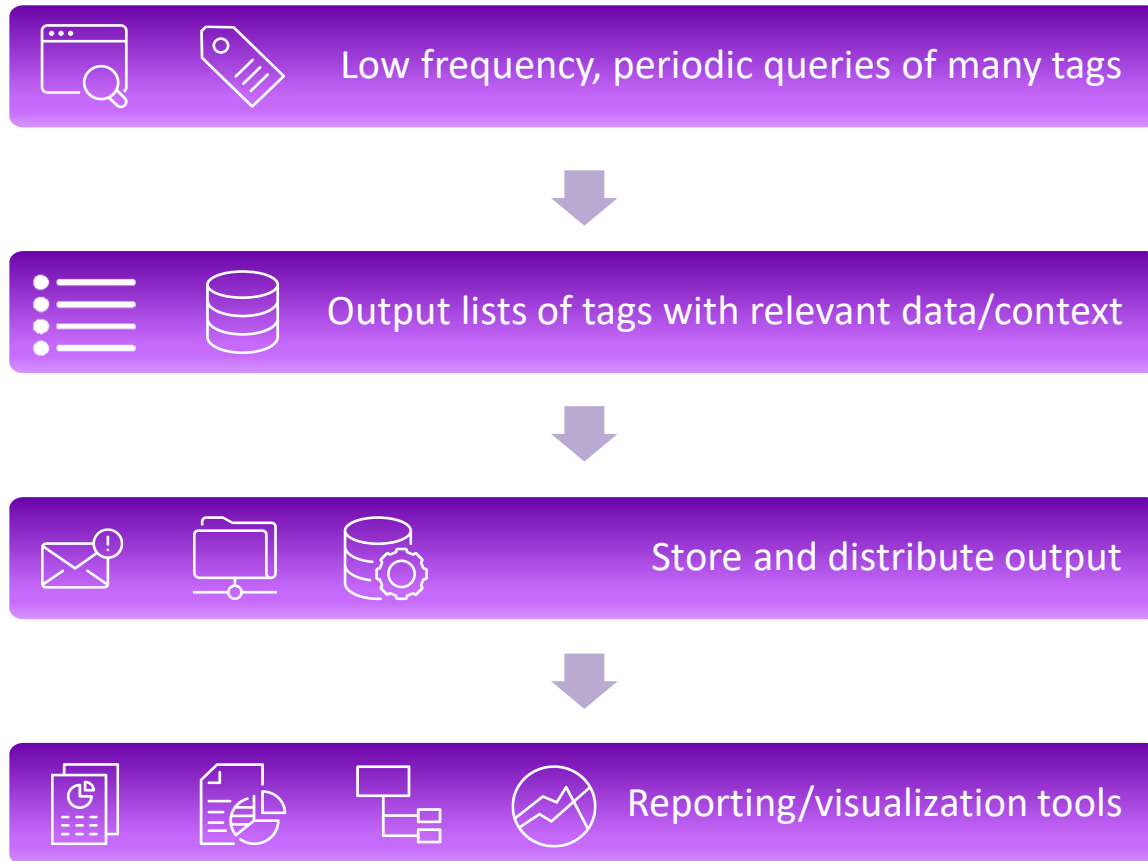
Example reporting options

o Excel
  o Filters
  • Pivot table/chart

• BI tools
  o Slice and dice on dimensions like failure type, point source, interface machine name, etc.

• AVEVA™ PI Vision™ dashboards
  o Summary values written to PI points
  o AF elements

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Bulk Method: Reporting

Simple example in Excel with pivot table and chart

	Count	Percent	
ACTIVE	683	86%	Points with recent good data
STALE	16	2%	Points with no recent data
BAD	42	5%	Points with bad value but good previously
FLATLINE	4	1%	Points with unchanging values
NEW	40	5%	Points with no good data but are new
DELETE	9	1%	Points with no good data but are old
DELETED	0	0%	Points deleted (refresh only)
ERROR	0	0%	Points that failed to be analysed
TOTAL	794		

Control | **Dashboard** | Report | Settings | Build | ⊕

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To Summarize

- Presented methods to help increase AVEVA PI System data reliability

- Suggested approaches:

Better governance and change management

Use of high availability architectures
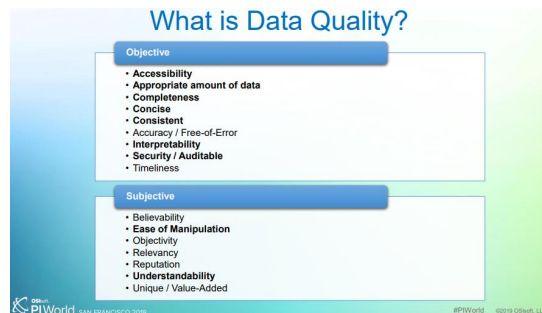
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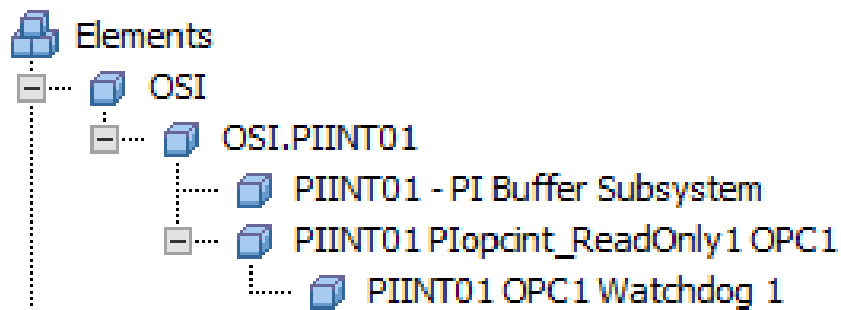
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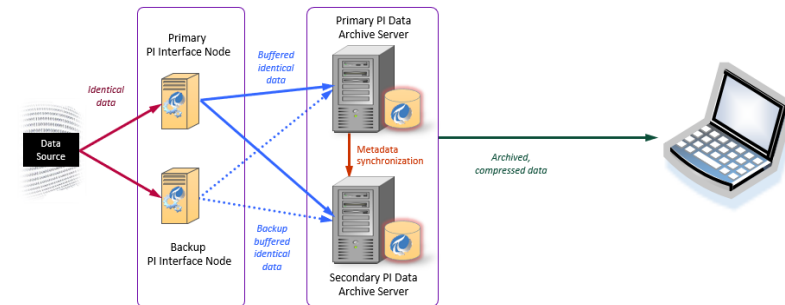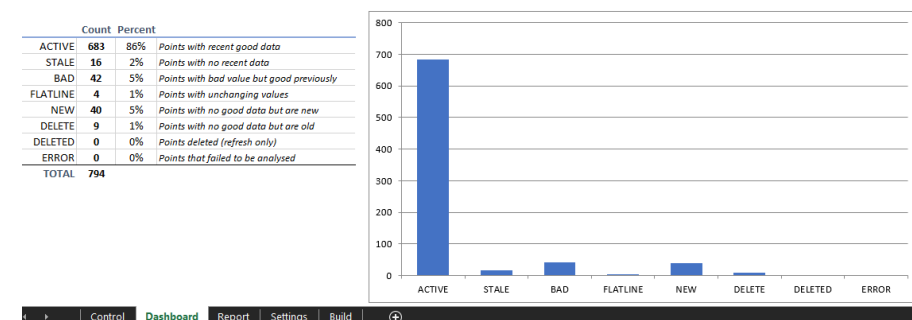
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Questions?

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.

Thank you!

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