

PI 101: PI System Basics

Kevin Doherty – Systems Engineer
Stuart Collins – Product Marketing Manager

March 23, 2017

Live Polling in this
session:
Pollev.com/stuartc



We believe People with Data

Respond at → PollEV.com/stuartc

What industry are you are from?

Power Generation
Power Transmission & Distribution
Pulp & Paper
Oil & Gas
Food & Beverage
Water Utility
Mining, Metallurgy, Metals
Pharmaceuticals
Transportation (Planes, Trains, Boats, Automobiles)
Data Centers

Start the presentation to activate live content

If you see this message in presentation mode, install the add-in or get help at PollEV.com/app

0%

Building the PI 101 agenda:

Its Day 3 of the UC

- What gaps are in your knowledge?
- What else do you want to do with the PI System?
- What can we clarify?
- Simply put, what remaining questions do you have?

Live Polling:
Pollev.com/stuartc

Respond at → PollEV.com/stuartc

What PI 101 questions do you have?

1

Will this connect to IOC?

-1

How long does this take to j stall?

Start the presentation to activate live content

If you see this message in presentation mode, install the add-in or get help at PollEv.com/app

PI 101 Agenda

- PI System 10,000 ft. view
- Power of the PI Server
- How to visualize PI System data
- How to build a PI System

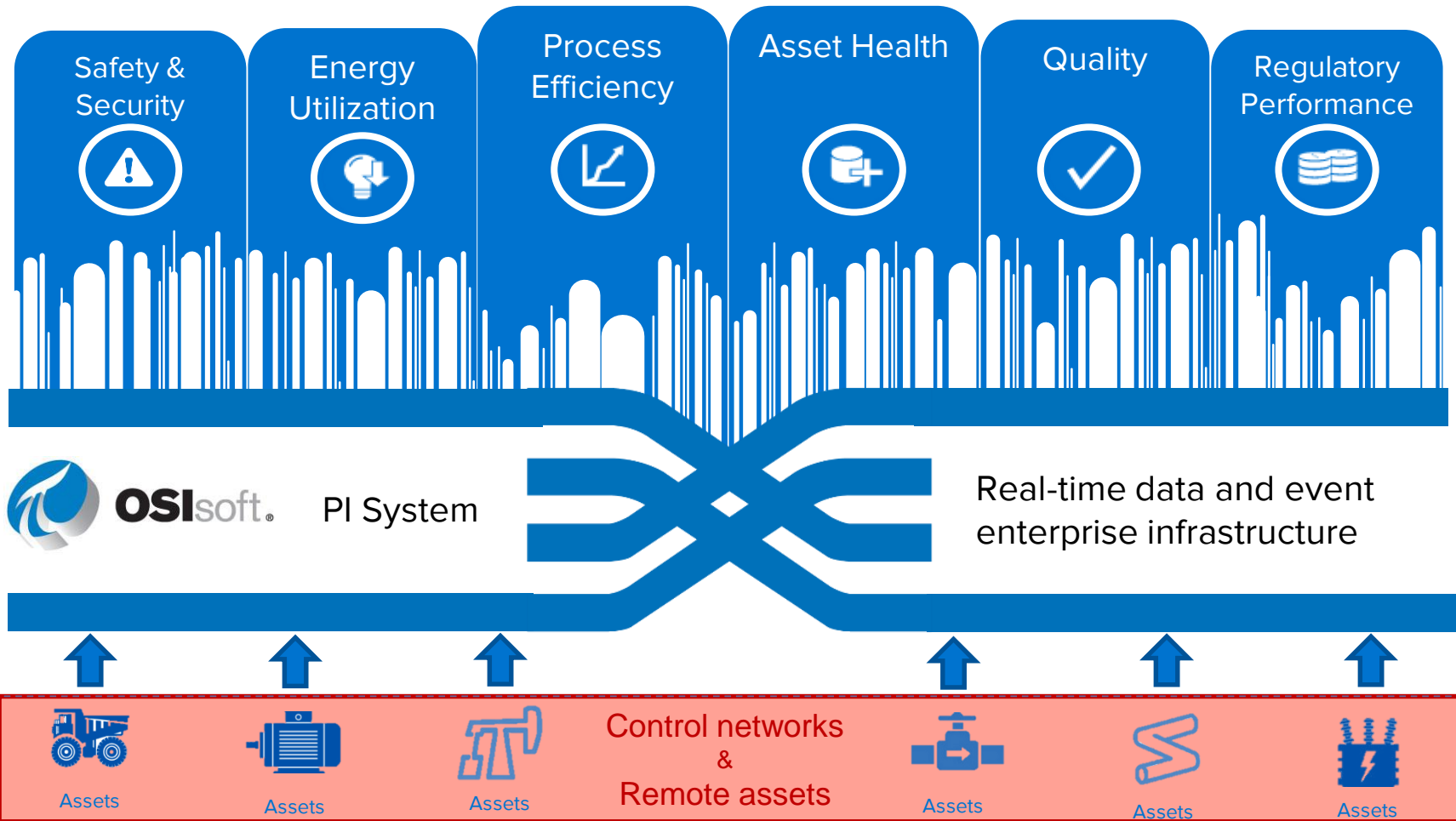
The PI System is operations software

The PI System
appears here

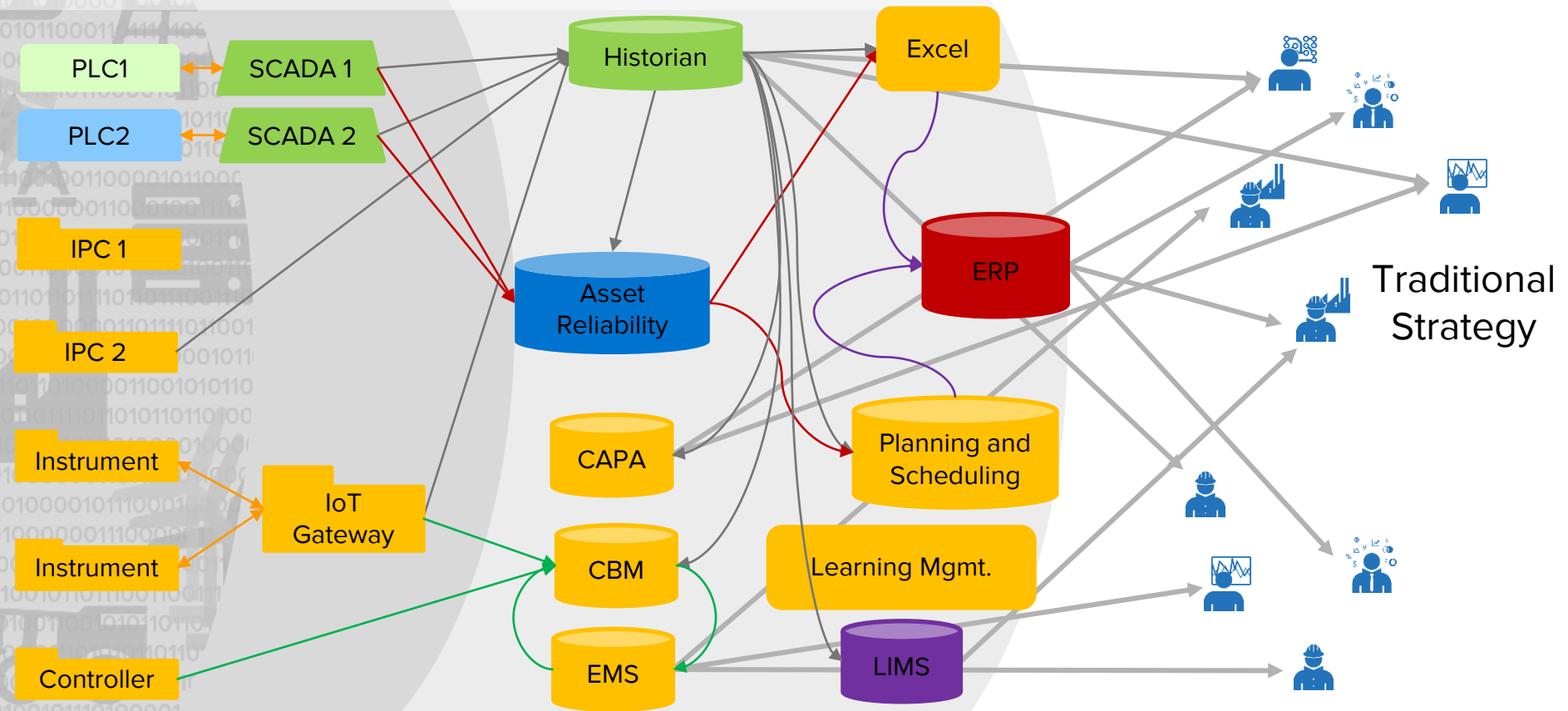


Big Data
aggregation
software

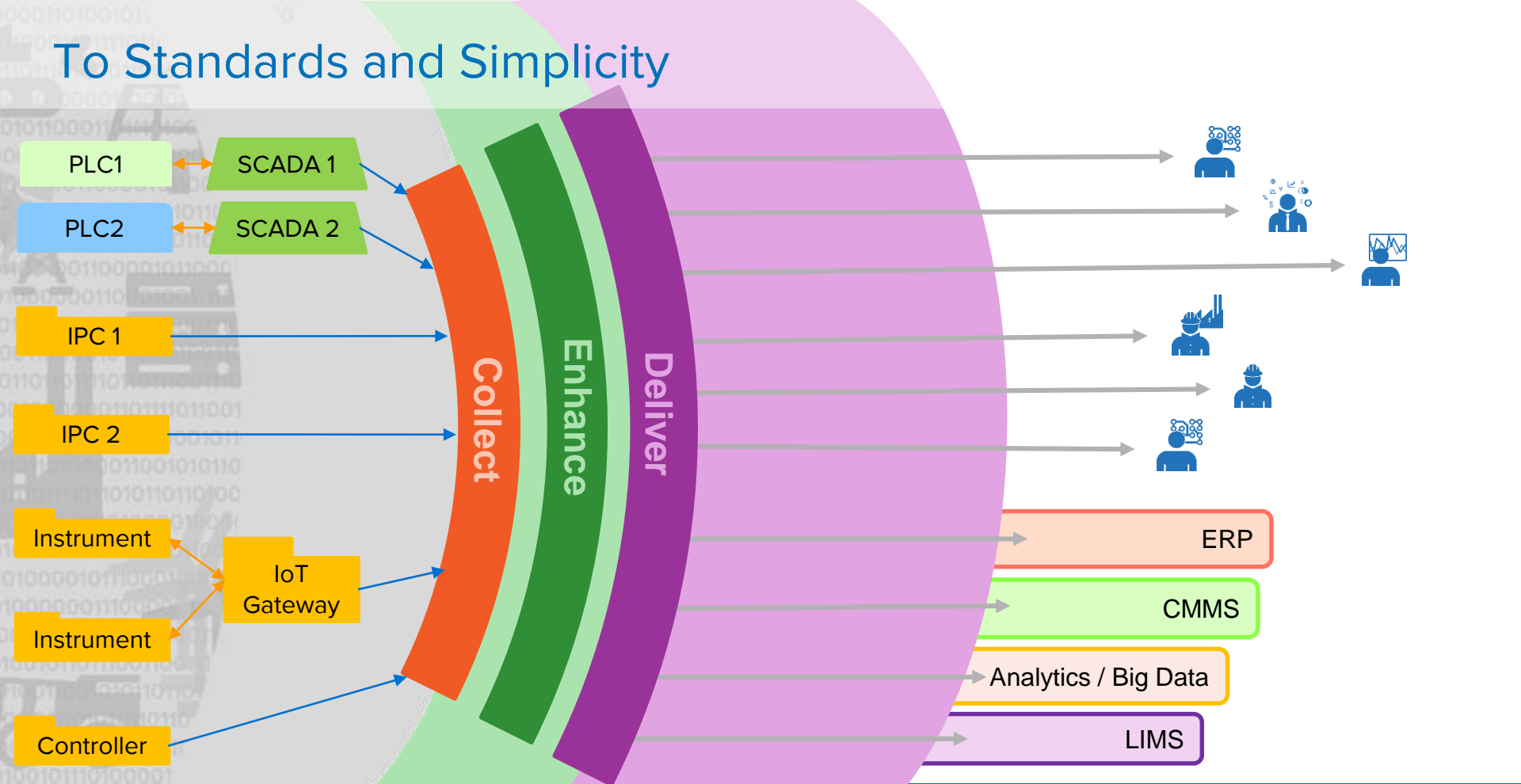




From Silos and Complexity



To Standards and Simplicity



One Common Infrastructure for your Operational Data

Collect

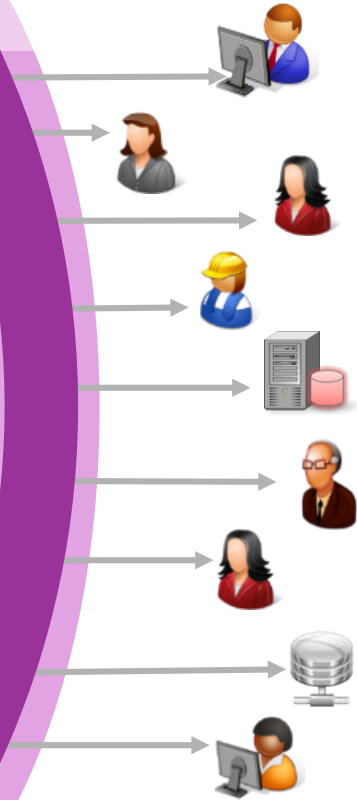
Manage
Enhance

Deliver

PI Interfaces,
PI Connectors

PI Server

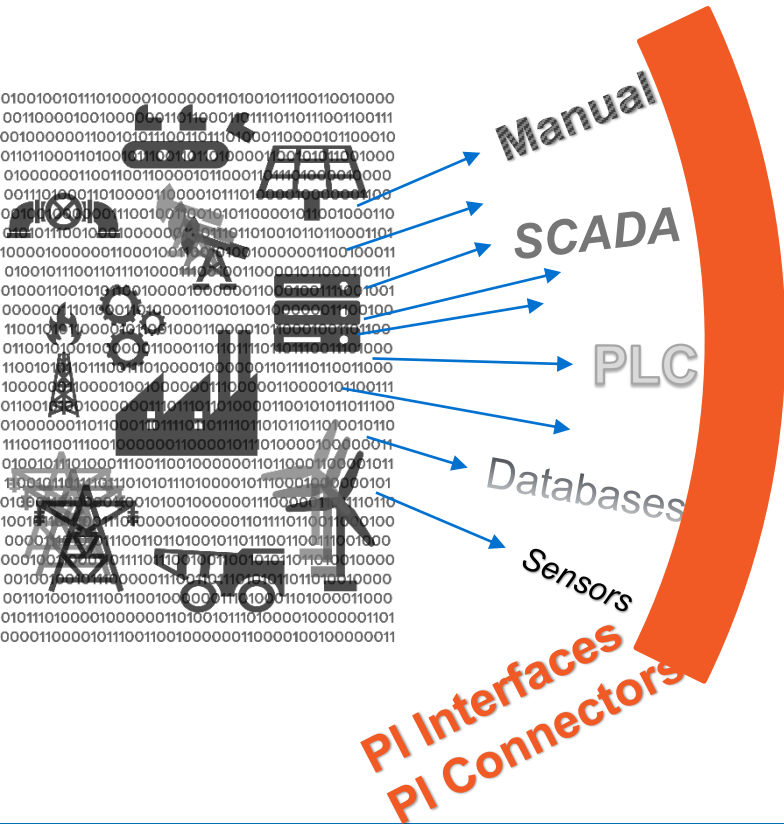
To Users
and Systems



Data collection & the PI Server



Connectivity – PI Interfaces & PI Connectors



Native connections

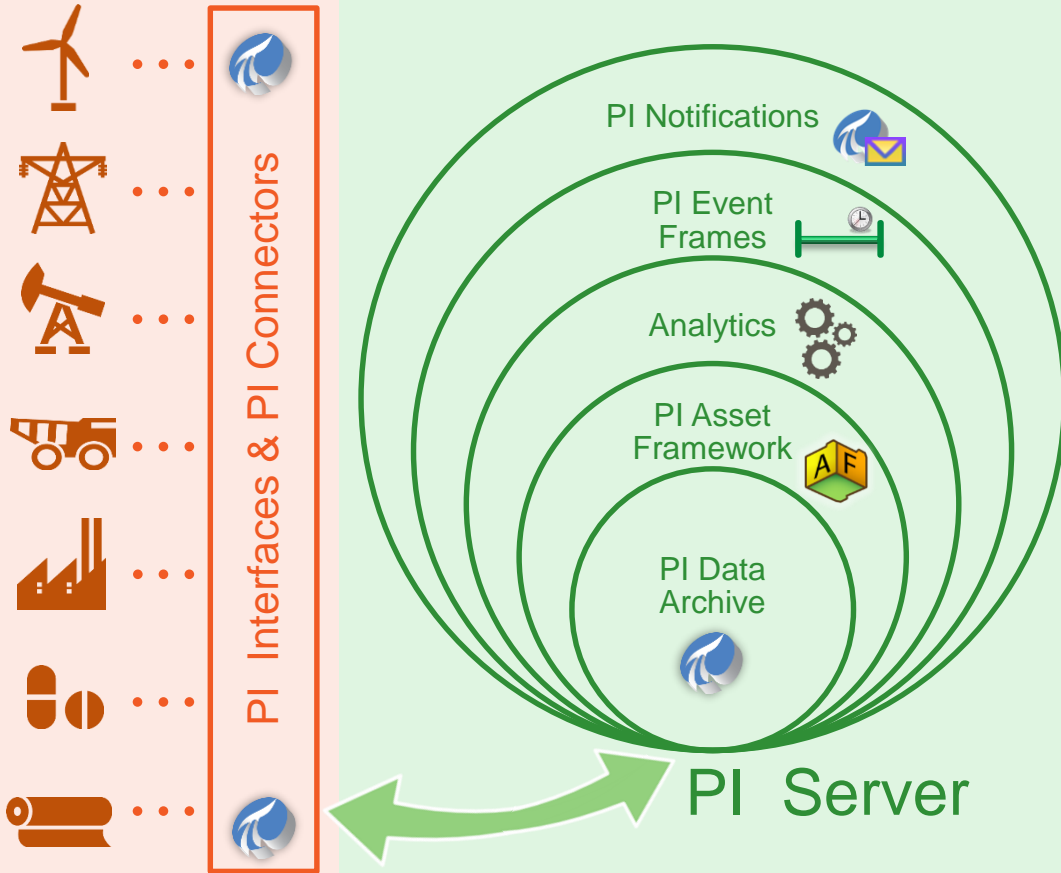
to 100s of data sources

Configurable connections

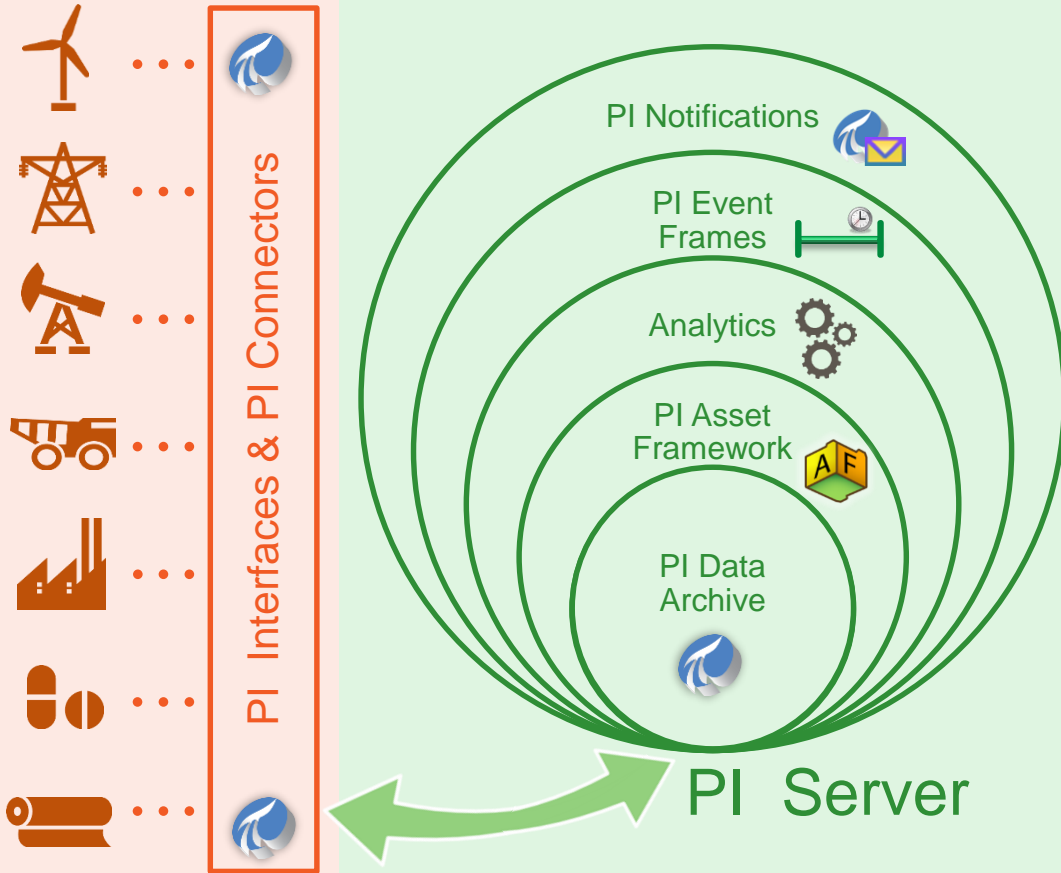
to everything else

- PI Connector for OPC
- PI Connector for UFL (and REST)
- PI Connector for Wonderware Historian
- PI Manual Logger
- PI Interface for Relational Database
- PI Interface for HTML
- And ~300 more...

PI System Infrastructure



PI System Infrastructure





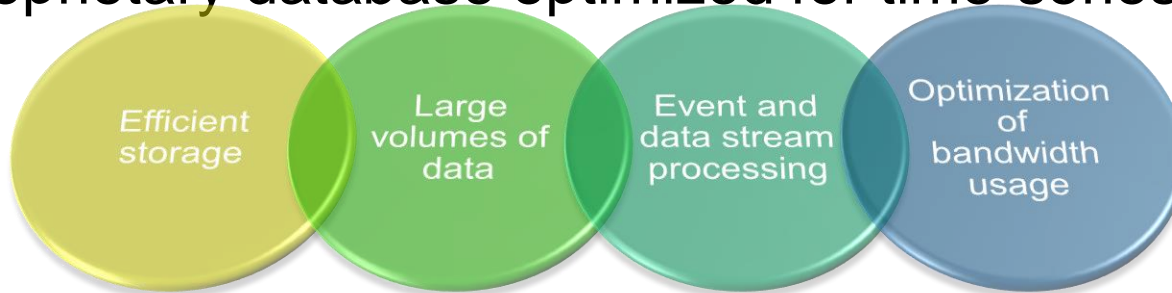
PI Data Archive (Time-Series Database / “Historian”)

- Real-time data stream/sensor reading → PI Tag

TAG	TIME	VALUE	STATUS
TIC1001.PV	23-MAY-16 11:01:02	12.3	GOOD
LIC30211.PV	23-MAY-16 11:01:03	198.4	GOOD

....

- Proprietary database optimized for time-series data



Proven Engine – PI Server

Core Capabilities

System of Record

Real-time Processing

Data Calculations

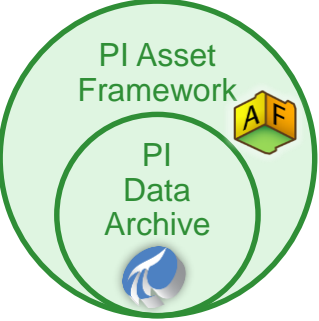
Alerting Engine

Metadata Layer

Event Tagging

	PI Data Archive
Max PI Tag Count	20M+
Startup Time	<30 sec/Mtags
Data Out (Archive)	>10M ev/sec
Data In (Snapshot)	>1M ev/sec
Data In (Archive)	>500K ev/sec





Asset Framework

- A virtual asset for each physical asset
- Virtual assets are organized by physical and logical relationships
- Allows inclusion of meta data (information *about* the data)

Tag Name

02MBA01CG101
 02MBA01CS001
 02MBA01CT001
 02MBA01CT002
 02MBH05CT001
 02MBL01CP501
 02MBL01CT001
 02MBN11CF101
 02MBN11CT101
 02MBN12CP106
 02MBN12CPAVE2



Elements

- Elements
 - PaperCo
 - Kappa
 - Montreal Mill
 - Bleaching
 - Papermaking Machines
 - MTL:PM1
 - Profile
 - MTL:PM2
 - Recycled Pulp Process
 - Virgin Pulp Process
 - Paper Machines
 - Seattle Mill

- Element Searches
- Attribute Search 1

MTL:PM1

General | Child Elements | **Attributes** | Ports | Analyses | Notification Rules | Version

Filter

	Name	Value
<input checked="" type="checkbox"/>	Basis Weight	51.95576 lb
<input type="checkbox"/>	Broke Cost	93.75 \$
<input type="checkbox"/>	Broke Flow	228.65 ft/m
<input type="checkbox"/>	Children Element Attribute	71
<input checked="" type="checkbox"/>	Grade	RECYCLE3
<input checked="" type="checkbox"/>	GrdIndex	5
<input checked="" type="checkbox"/>	Gross Tons	84 tpd
<input checked="" type="checkbox"/>	ID	MTL:PM1
<input checked="" type="checkbox"/>	Machine Availability	Available

Analytics & Templates

Process

→ Boiler Efficiency = $AVG(B1..Bn)$

Boiler1

Flow Out

Fuel Flow Rate

Efficiency = $Steam\ Flow\ Out / Fuel\ Flow\ Rate * (h_s - h_{fw}) / HHV$

Boiler2

Flow Out

Fuel Flow Rate

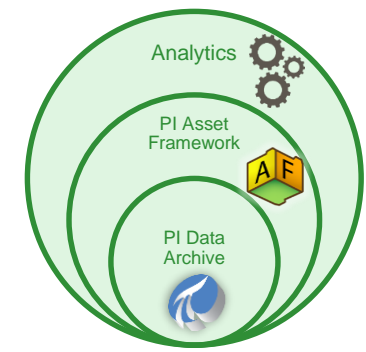
Efficiency

Boiler3

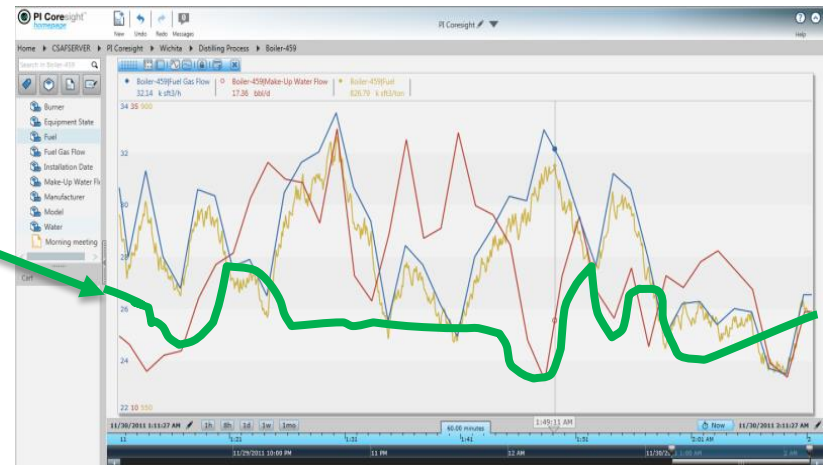
Flow Out

Fuel Flow Rate

Efficiency



Boiler Template



Complex equations and analytics

General Child Elements Attributes Ports Analyses Version

Name Backfilling

f_∞ THA Scoring

Analysis Type: Expression Rollup Event Frame Generation

Evaluate

Name	Expression	Value	Output Attribute
n2score	IF 'n2' <=50 THEN 9 ELSE IF 'n2' <=100 THEN 5 ELSE IF 'n2' <=250 THEN 3 ELSE 1		THA Score DGA Score n2 Score
C2H4Score	IF 'C2H4' <=50 THEN 9 ELSE IF 'C2H4' <=100 THEN 5 ELSE IF 'C2H4' <=250 THEN 3 ELSE 1		THA Score DGA Score C2H4 Score
TotalGasScore	IF 'Total Gas' <=719 THEN 9 ELSE IF 'Total Gas' <=1919 THEN 5 ELSE IF 'Total Gas' <=4629 THEN 3 ELSE 1		THA Score DGA Score COMB. GAS S
C2H6Score	IF 'C2H6' <=65 THEN 9 ELSE IF 'C2H6' <=100 THEN 5 ELSE IF 'C2H6' <=150 THEN 3 ELSE 1		THA Score DGA Score C2H6 Score
CH4Score	IF 'CH4' <=120 THEN 9 ELSE IF 'CH4' <=250 THEN 5 ELSE IF 'CH4' <=400 THEN 3 ELSE 1		THA Score DGA Score CH4 Score
COscore	IF 'CO' <=350 THEN 9 ELSE IF 'CO' <=570 THEN 5 ELSE IF 'CO' <=1400 THEN 3 ELSE 1		THA Score DGA Score CO Score
CO2Score	IF 'CO2' <=2500 THEN 9 ELSE IF 'CO2' <=4000 THEN 5 ELSE IF 'CO2' <=10000 THEN 3 ELSE 1		THA Score DGA Score CO2 Score
DGAScore	0.46*C2H2Score + 0.09*H2Score + 0.15*C2H4Score + 0.1*TotalGasScore + 0.05*C2H6Score + 0.05*CH4Score		THA Score DGA Score
LoadScore	IF 'Load'/'MVA' <=0.7 THEN 9 ELSE IF ('Load'/'MVA' >=0.7 and 'Load'/'MVA' <=0.9) THEN 5 ELSE IF 'Load',		THA Score Load Score
THAScore	(DesignScore*0.15 + MfgScore*0.1 + AgeScore*0.15 + DGAScore*0.35 + LoadScore*0.25)/9*100		THA Score

Add a new expression

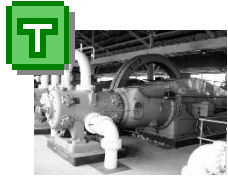
Scheduling: Event-Triggered Periodic

Trigger on Any Input

● Could not connect to the PI Analysis Service.



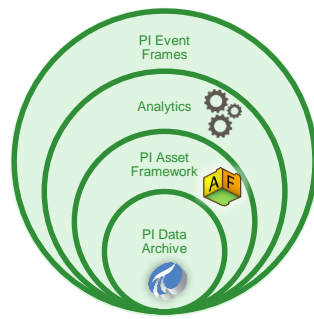
Event Frames



|Efficiency

|Fuel Flow Rate

|Flow Out



myEF

|Efficiency

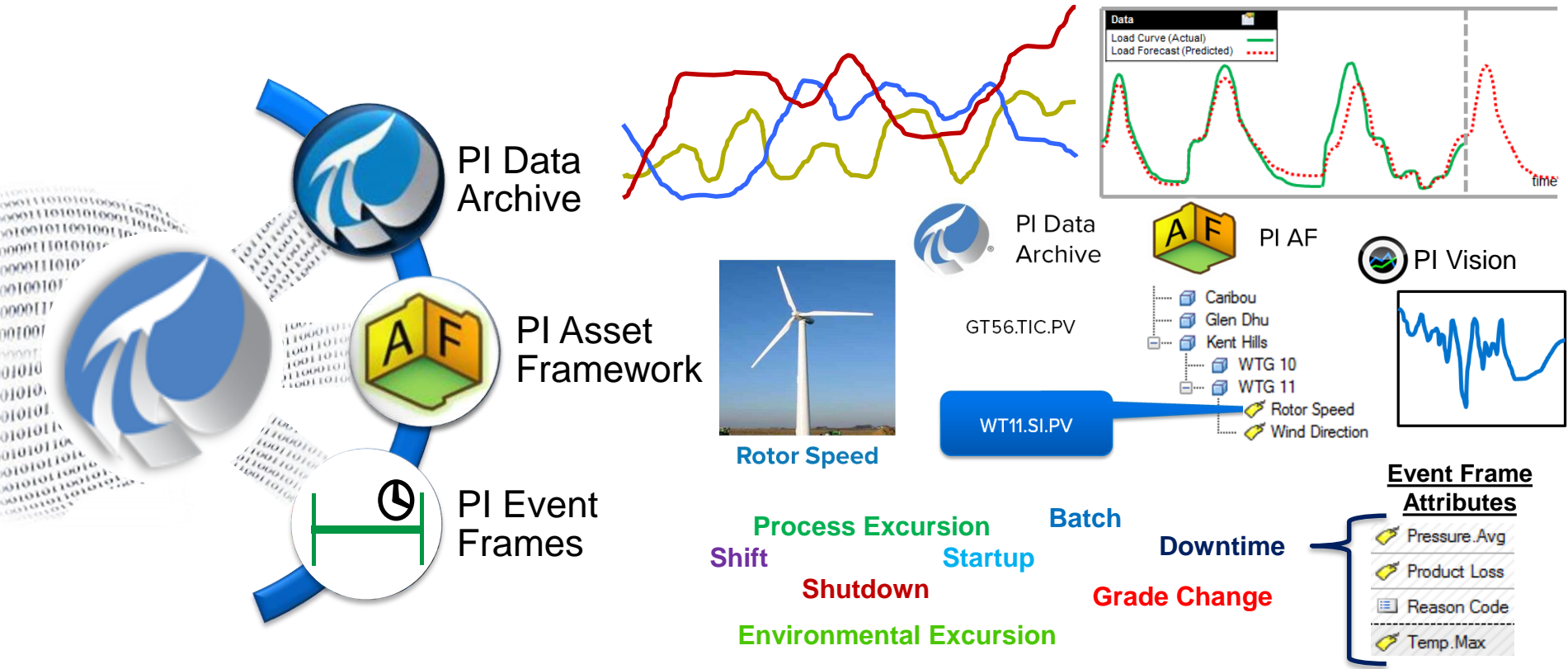


 **Efficiency** = (**Flow Out** / **Fuel Flow Rate** * 3.14)

 **myEF.Start** = (**Efficiency** < LIMIT)

myEF.End = (**Efficiency** > LIMIT) AND (**Fuel Flow Rate** > 25)

Time-Series Data, Assets, and Events



Trigger-based Notifications

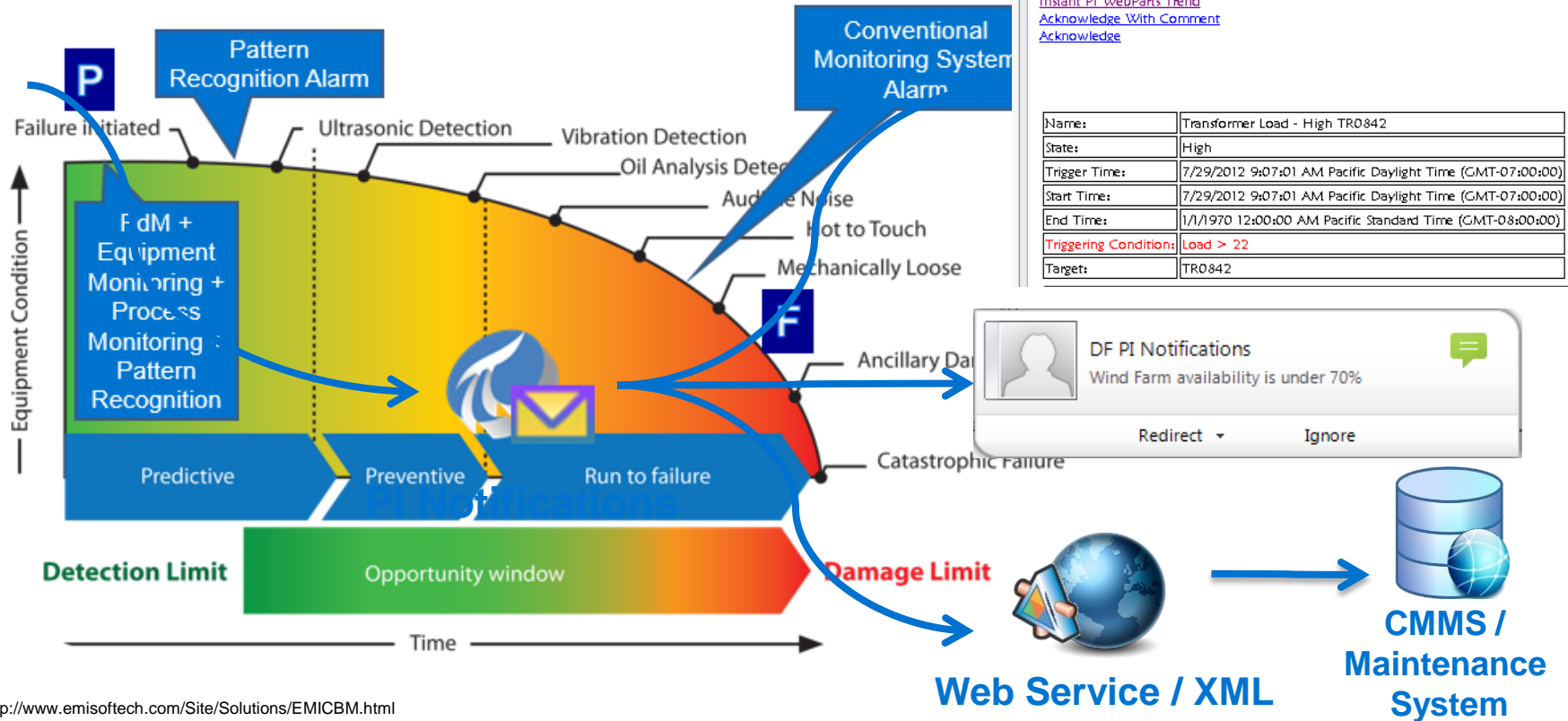
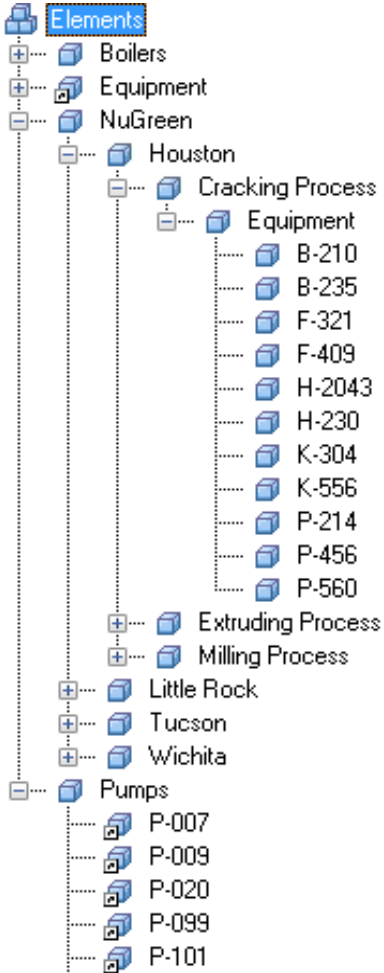


Image from <http://www.emisoftech.com/Site/Solutions/EMICBM.html>

Get the Complete Picture



Analyses

- Efficiency analysis
- Key Performance Indicators (KPI)

Events

- Downtime
- Startup
- Failure

Notifications

- High speed
- Rotor failure
- Low pressure

Time-series

- In-Flow
- Pressure
- Vibration data

Asset details

- Name
- Model
- Manufacturer

External data

- Performance curves
- Last maintenance date
- Design documents
- Best operating procedures



Respond at → PollEV.com/stuartc

What PI 101 questions do you have?

1



Will this connect to IOC?



-1

How long does this take to j stall?

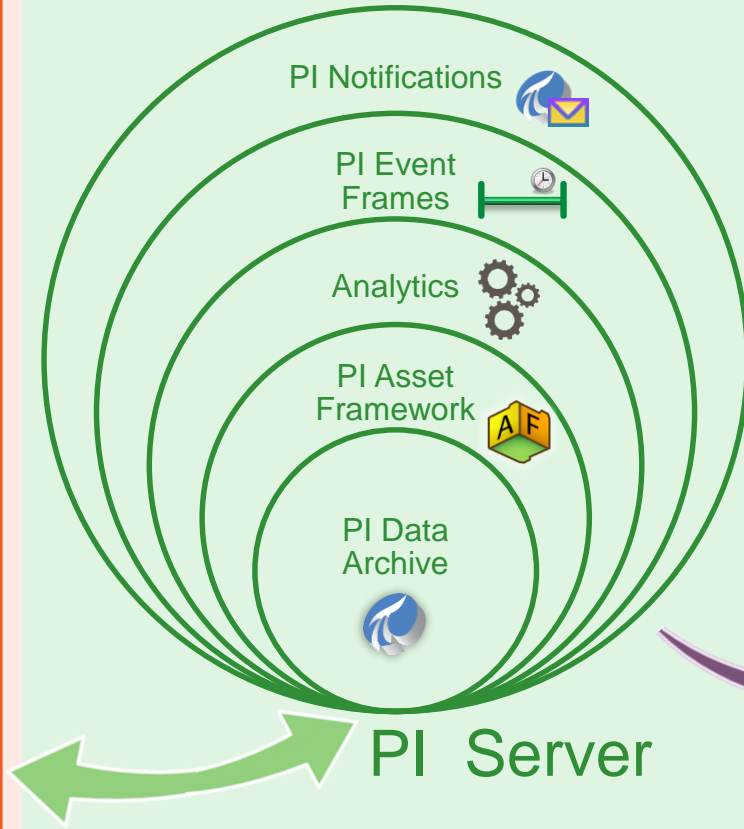
Start the presentation to activate live content

If you see this message in presentation mode, install the add-in or get help at PollEv.com/app

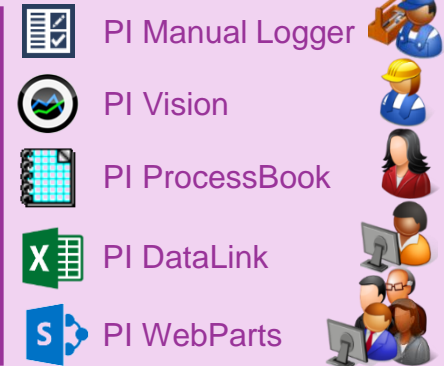
PI System Visualization



PI System Infrastructure



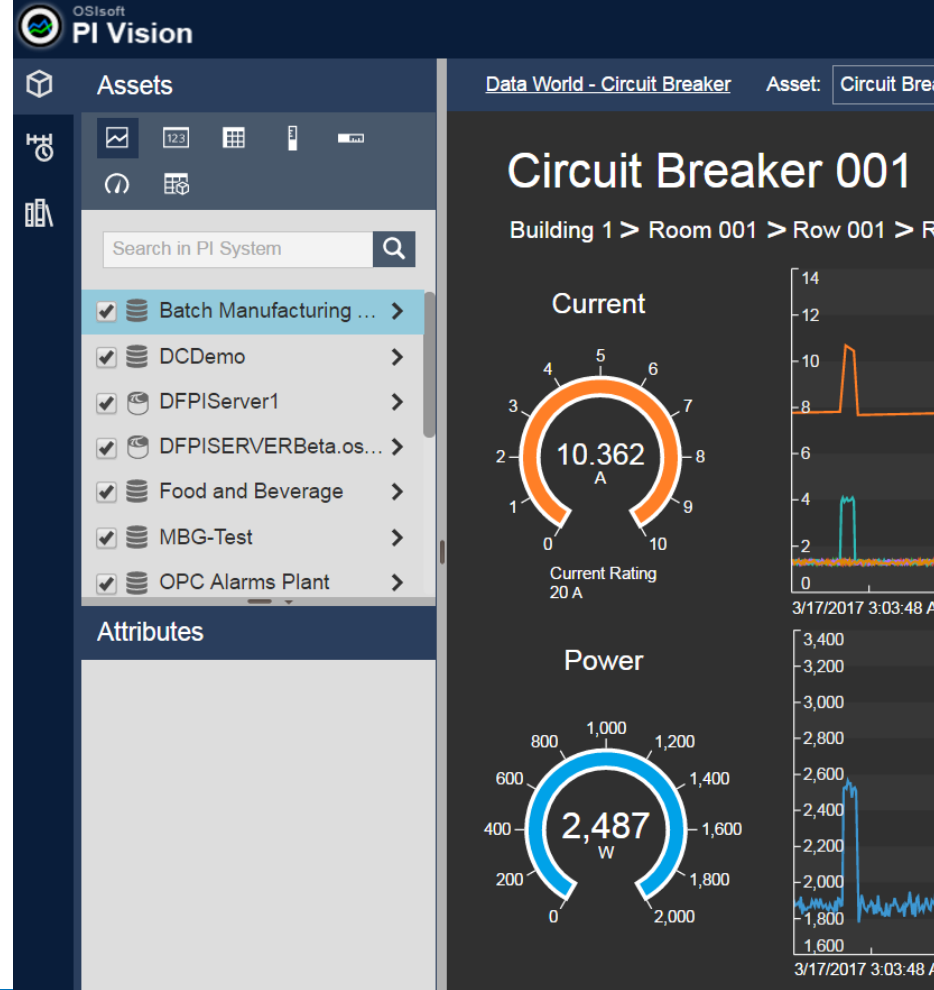
PI Visualization Suite



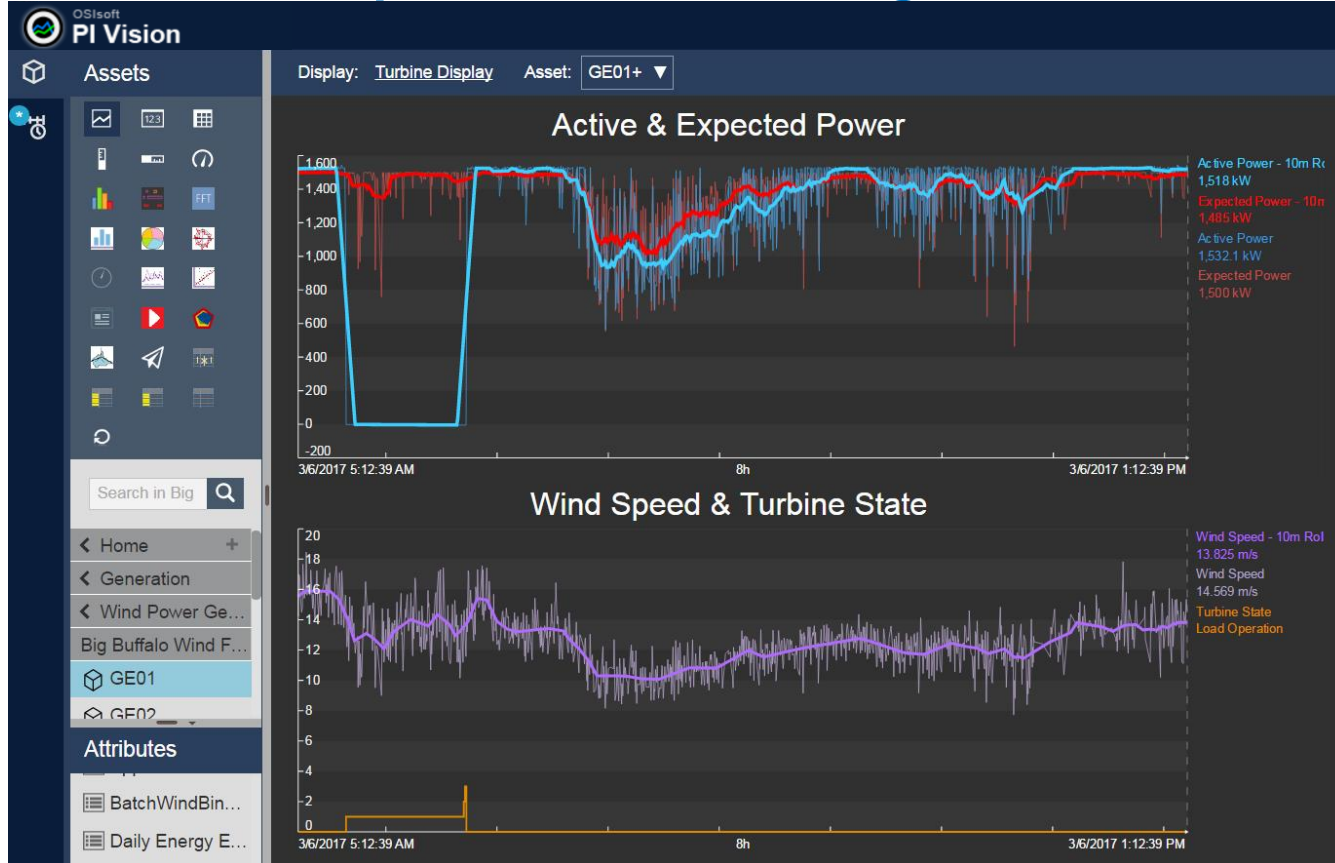
PI Vision

Modern and intuitive web tool:

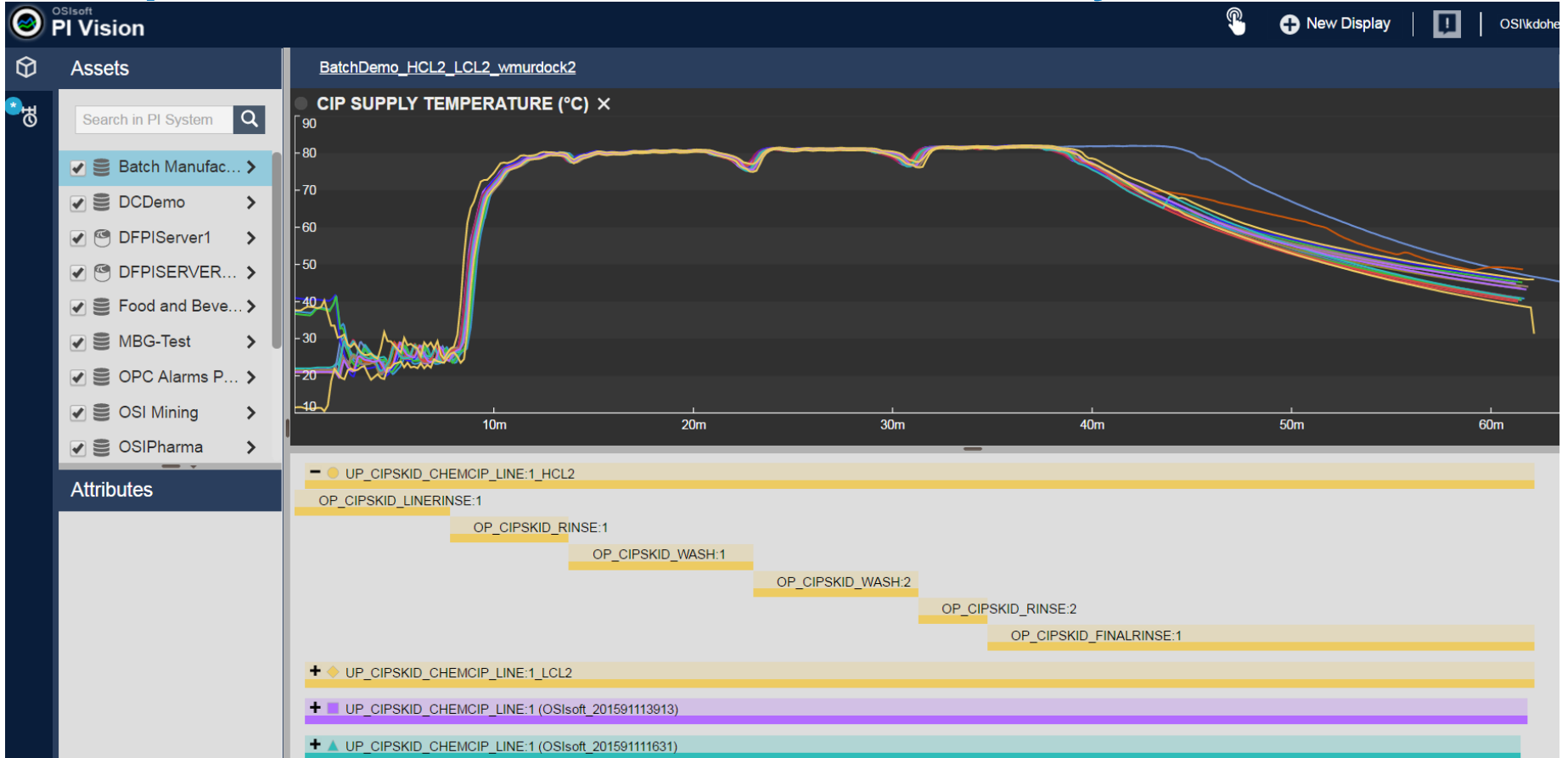
- **Efficient search**
- **Rapid screen creation**
- **Intuitive learning** of its functionalities
- Facilitated **collaboration** and **sharing of insights**



Compare modeled and predicted datasets against live sensor data



Compare similar events with event overlays



PI DataLink

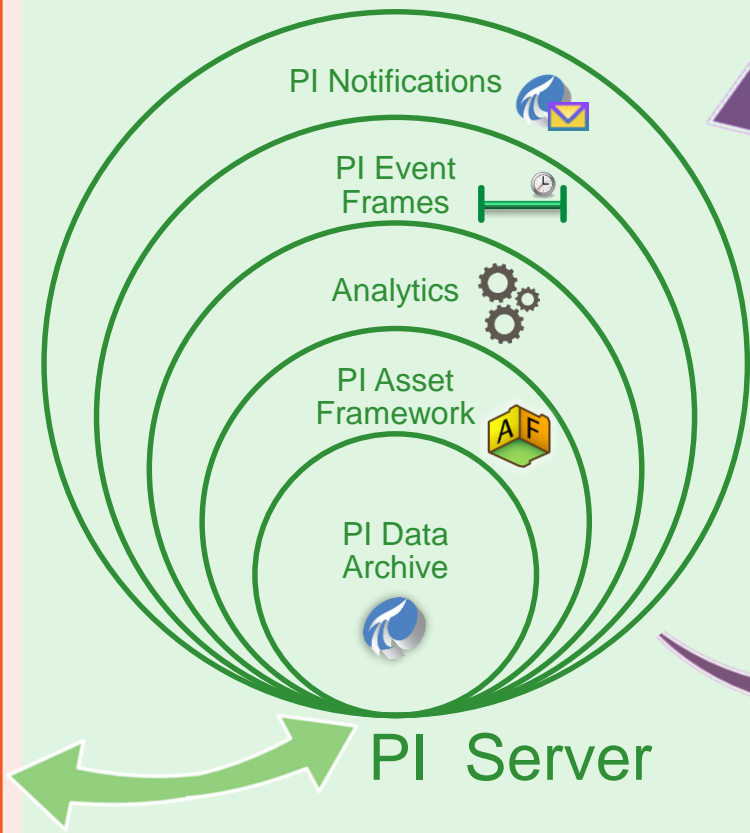
- PI System data in **Microsoft Excel**
- Allows **summary calculations** and **filtering** of the data
- Access to **Excel functionalities**

	A	B	C	D	E
	Du	09-May-2012 09:00			
	Au	10-May-2012 09:00			
Date	BA:CONC.1	BA:LEVEL.1	BA:PHASE.1	BA:TEMP.1	
09-May-2012 09:00:27	43.93	3.60	Phase3	2.12	▼
09-May-2012 09:00:57	0.00	2.93	Phase3	1.41	▼
09-May-2012 09:17:27	6.37	11.64	Phase1	10.32	▼
09-May-2012 09:29:27	19.39	21.89	Phase3	17.91	▼
09-May-2012 09:52:57	24.68	37.74	Phase4	27.53	▼
09-May-2012 10:01:27	40.86	34.79	Phase5	46.73	▬
09-May-2012 10:21:27	44.23	0.16	Phase1	7.09	▼
09-May-2012 10:21:57	0.00	0.24	Phase1	6.60	▼
09-May-2012 10:37:27	6.16	10.97	Phase1	8.88	▼
09-May-2012 10:55:27	23.30	27.33	Phase3	20.18	▼
09-May-2012 11:17:27	29.37	39.17	Phase4	33.67	▼
09-May-2012 11:23:27	42.29	35.50	Phase5	45.63	▬
09-May-2012 11:42:27	46.19	0.47	Phase1	8.45	▼
09-May-2012 11:42:57	0.00	0.52	Phase1	7.94	▼
09-May-2012 11:56:57	4.39	6.63	Phase1	6.95	▼
09-May-2012 12:14:27	21.23	25.19	Phase3	21.46	▼
09-May-2012 12:34:57	28.39	41.40	Phase4	31.31	▼
09-May-2012 12:43:57	42.42	40.52	Phase5	45.62	▬
09-May-2012 13:03:27	46.09	7.94	Phase1	6.73	▼
09-May-2012 13:03:57	0.00	7.38	Phase1	6.24	▼
09-May-2012 13:20:27	6.10	12.22	Phase1	12.22	▼

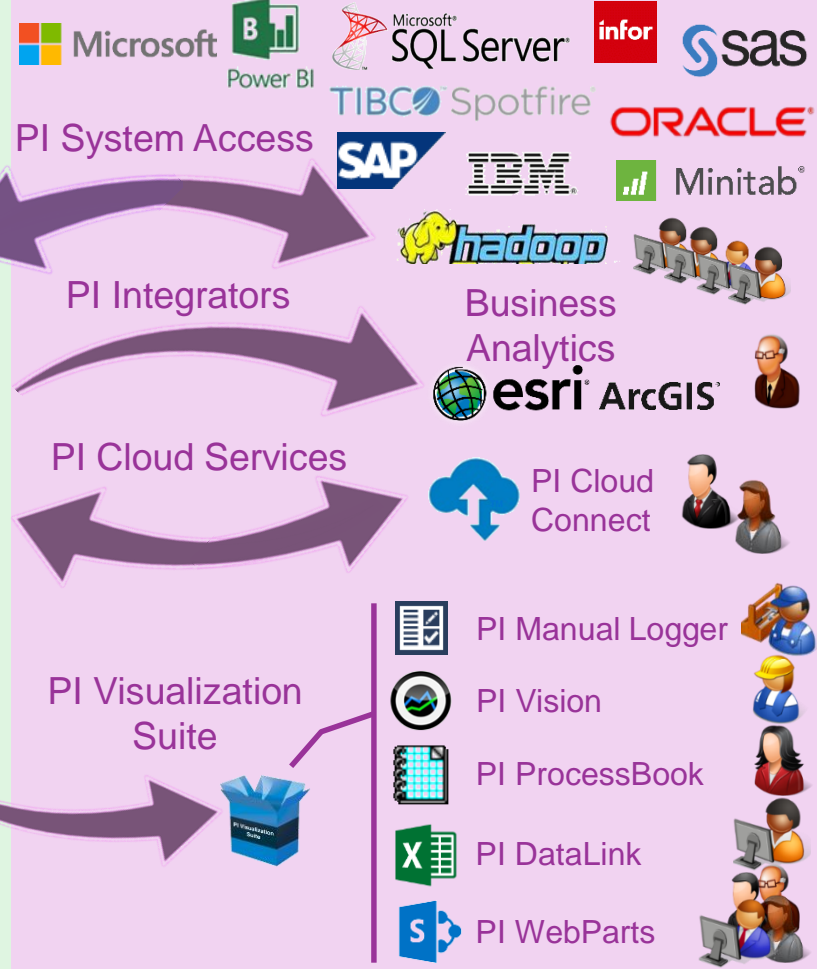
PI System Infrastructure



PI Interfaces & PI Connectors



PI Server



PI System Access

PI Integrators

PI Cloud Services

PI Visualization Suite

Business Analytics

PI Cloud Connect

PI Manual Logger

PI Vision

PI ProcessBook

PI DataLink

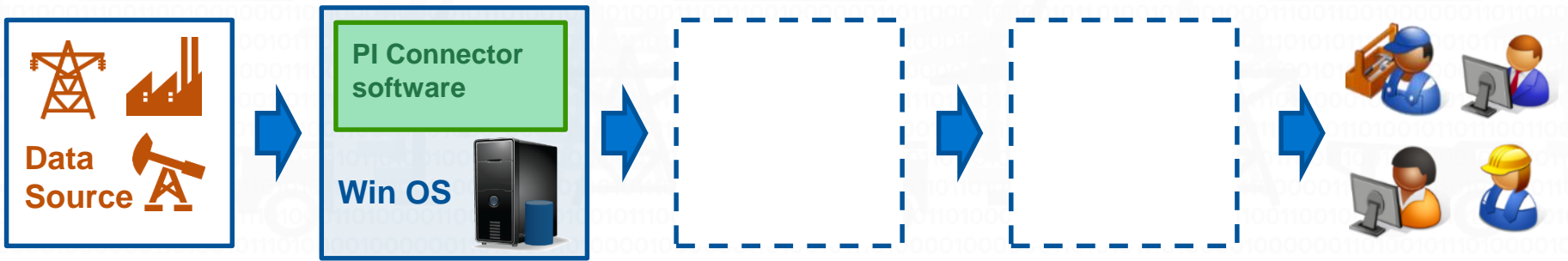
PI WebParts

Building a PI System

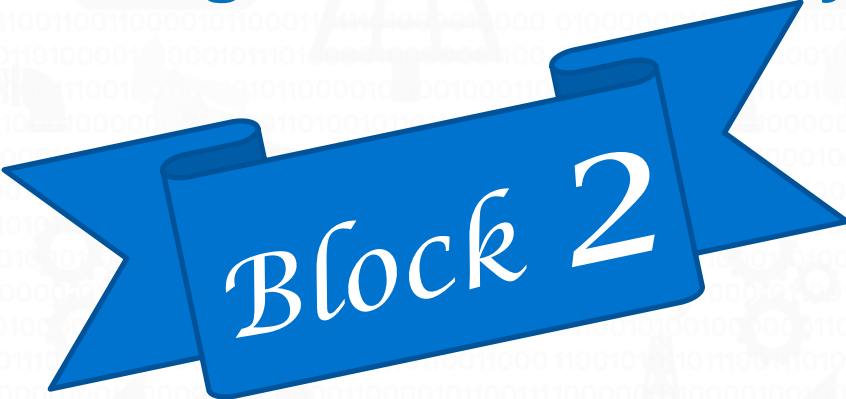


Building blocks of a PI System: Block 1

Block 1



Building blocks of a PI System: Block 2



VM and Cloud server hosting possible



Building blocks of a PI System: Block 3

Block 3

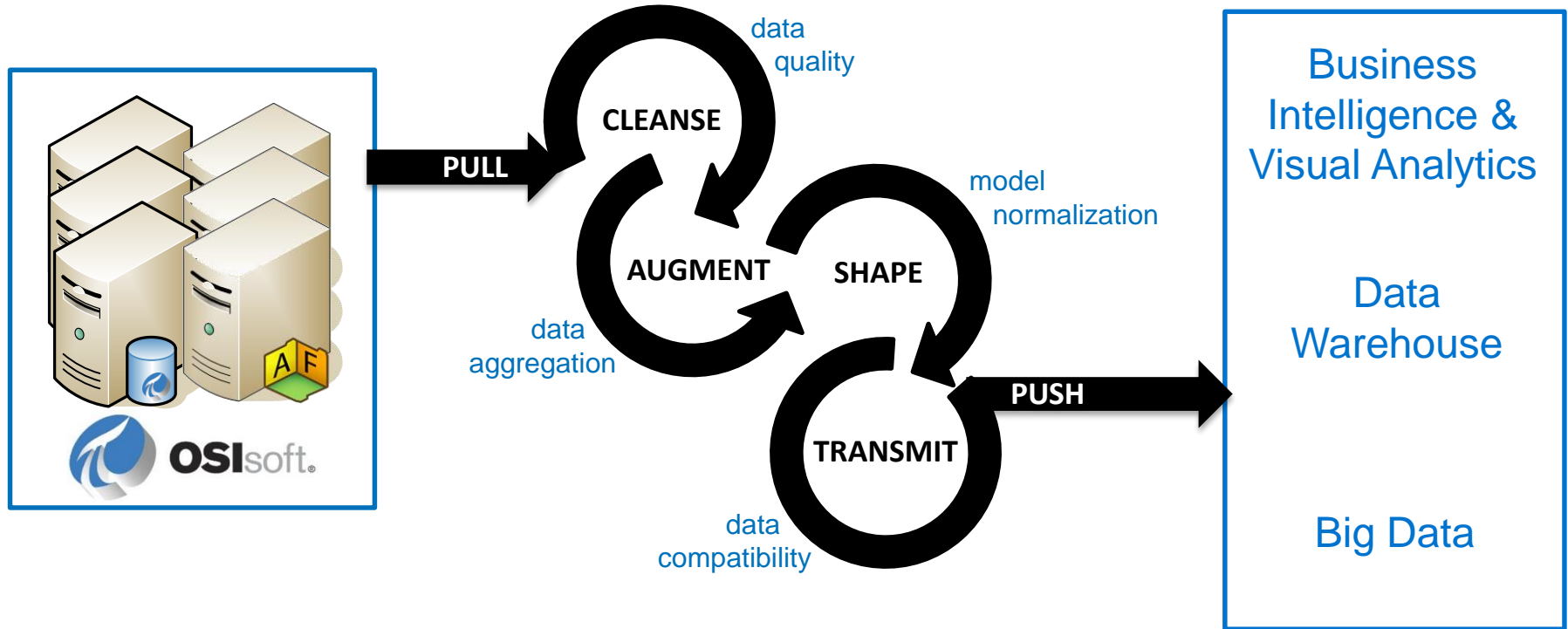


Questions Interlude

Next: Moving data from A → B



PI Integrator for Business Analytics



PI System data animates an ESRI map

The screenshot shows an ESRI map interface for 'Cat Canyon Operations'. The map displays a well field with various symbols representing different well types and flow rates. A legend on the left side of the map provides details for the symbols used. A popup window is open over a well, displaying its flow rate and other attributes.

Legend

Trucks

- Truck icon

Wells

- < 250 k sft 3/h (Red circle with sun)
- 250 - 300 k sft 3/h (Yellow circle with sun)
- > 300 k sft 3/h (Green circle with sun)

Cat Canyon Assets

Pipelines

- Crude Oil (Red line)
- LPG/NGL (Yellow line)
- Miscellaneous (Grey line)
- Natural Gas (Blue line)
- Petrochemical (Green line)
- Refined Products (Light Green line)

Facilities

- Black square

Interconnects

- Red circle with cross

Well Flow Rate: 57-ShX-14-H

Well	57-ShX-14-H
TheTimestamp	2012/10/03 3:46 PM
FlowRate	264.26
FlowTubingPressure	363.34
Longitude	-106.18
Latitude	43.26

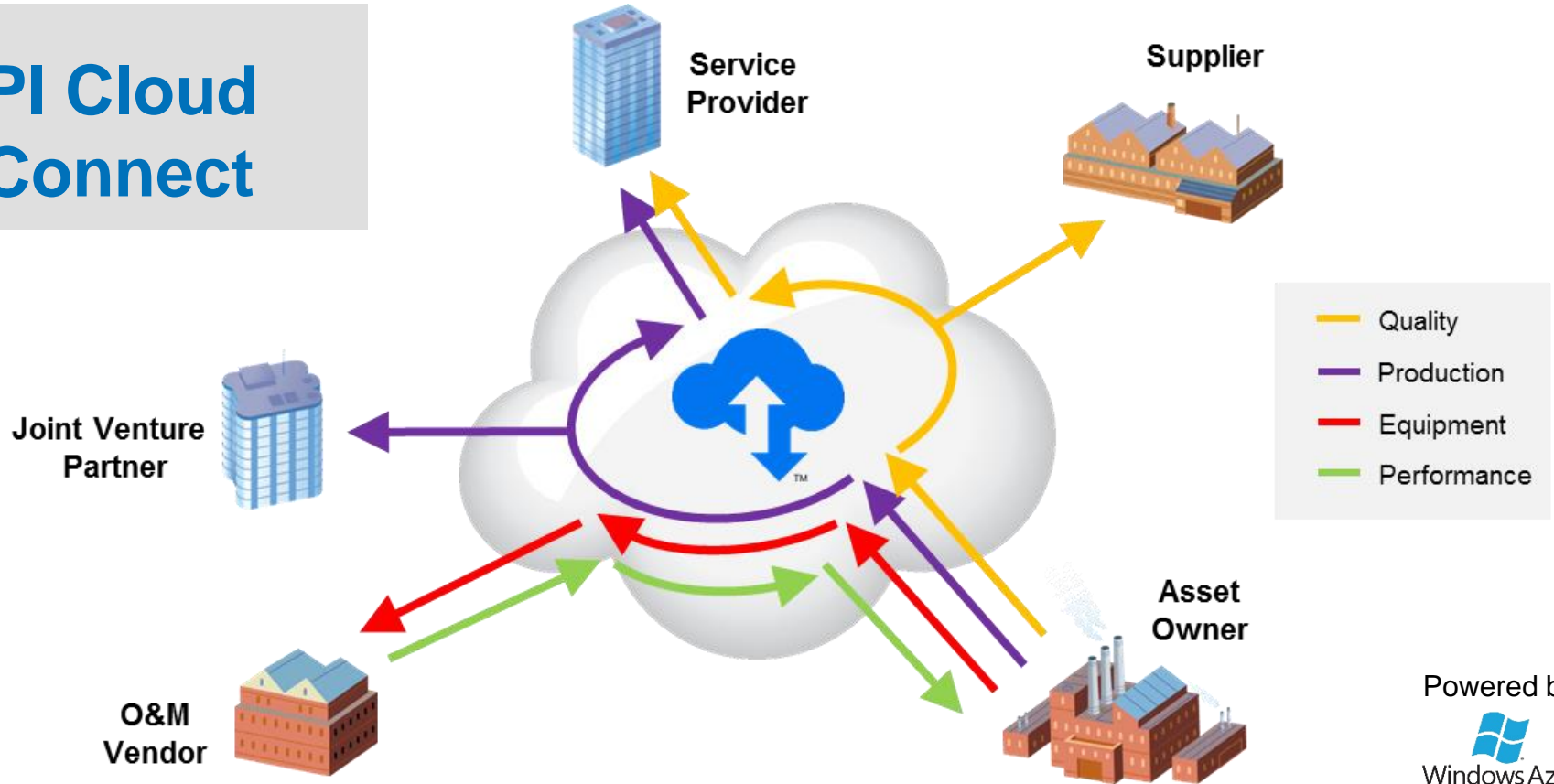
[Zoom to](#) [Get Directions](#) [Edit](#)

PI AF Template

Attribute Symbology

Current Value

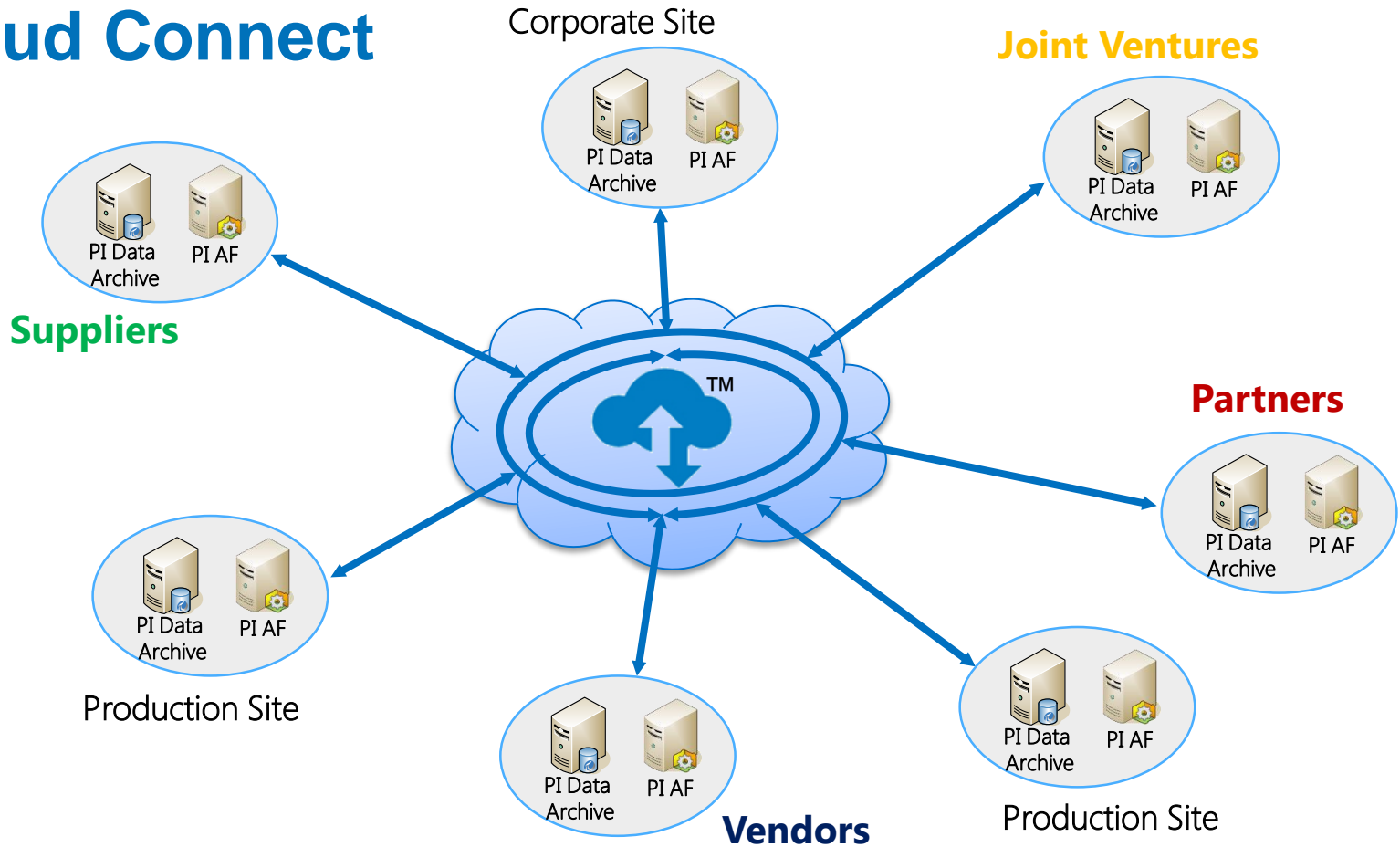
PI Cloud Connect



Powered by:



PI Cloud Connect



Powered by:

Windows Azure



Empowering Business in **Real-Time**.

© Copyright 2017 OSIsoft, LLC

Internet of Hotel Things (IoHT)

Experience **PI Vision** from your own device!



Enter our Data
Analysis Competition
for a chance to win a
**\$100 Amazon gift
card!!**

For more information visit

<https://ioht.osisoft.com>

***Sensors and connectivity
provided by the following
partners:*

B&B SMARTWORX
Powered by **ADVANTECH**

CIPHER

POWERED BY **RITTECH SOFTWARE**



**Have an idea how
to improve our
products?**

**OSIsoft wants to
hear from you!**

<https://feedback.osisoft.com/>



OSIsoft.

Empowering Business in **Real-Time.**

© Copyright 2017 OSIsoft, LLC

Respond at → PollEV.com/stuartc

What PI 101 questions do you have?

1

Will this connect to IOC?

-1

How long does this take to j stall?

Start the presentation to activate live content

If you see this message in presentation mode, install the add-in or get help at PollEv.com/app