

OSIsoft®

VIRTUAL CAMPUS

# PI PROGRAMMING 101

BUILDERS' CAFÉ WEBINAR SERIES

# AGENDA

- The PI System
- Programming with PI
- OSIssoft SDKs
- PI OLEDB Provider
- PI OPC DA/HDA Server
- Q&A


# VCAMPUS-EXCLUSIVE WEBINARS

- The Builders' Café Webinar Series
- Submit your ideas here:


Discussion Hall > All vCampus Forums > Generic vCampus Discussions

**GENERIC VCAMPUS DISCUSSIONS**



This forum is for generic discussions about the Virtual Campus, typically not programming-related.

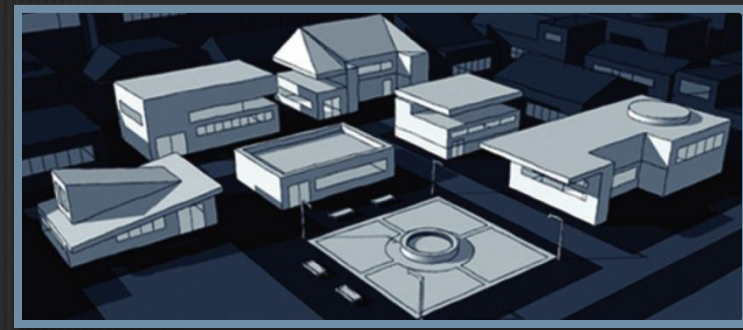
 [Write a New Post](#) Page 1 of 1 (9 items)

**Announcements and FAQs**

	Thread	Replies
	<b>Your ideas of topics for webinars!!</b> Latest post by RJK Solutions , Tue, Dec 2 2008 8:22 AM	3

**Topics**

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	<b>AF2.0 and Notification Forum</b> Latest post by RJK Solutions , Thu, Jan 29 2009 1:51 AM	8	<input type="checkbox"/>
	<b>RSS feeds &amp; Google Reader</b>		<input type="checkbox"/>



# THE PI SYSTEM

# THE PI SYSTEM



## Connect

Collect data from hundreds of sources.

**Interfaces**



## Manage

Gather and archive large volumes of data. Scale to meet your growing business needs.

**Servers**



## Analyze

Access real-time or historical role-based data for the entire enterprise at any time.

**Analytics**

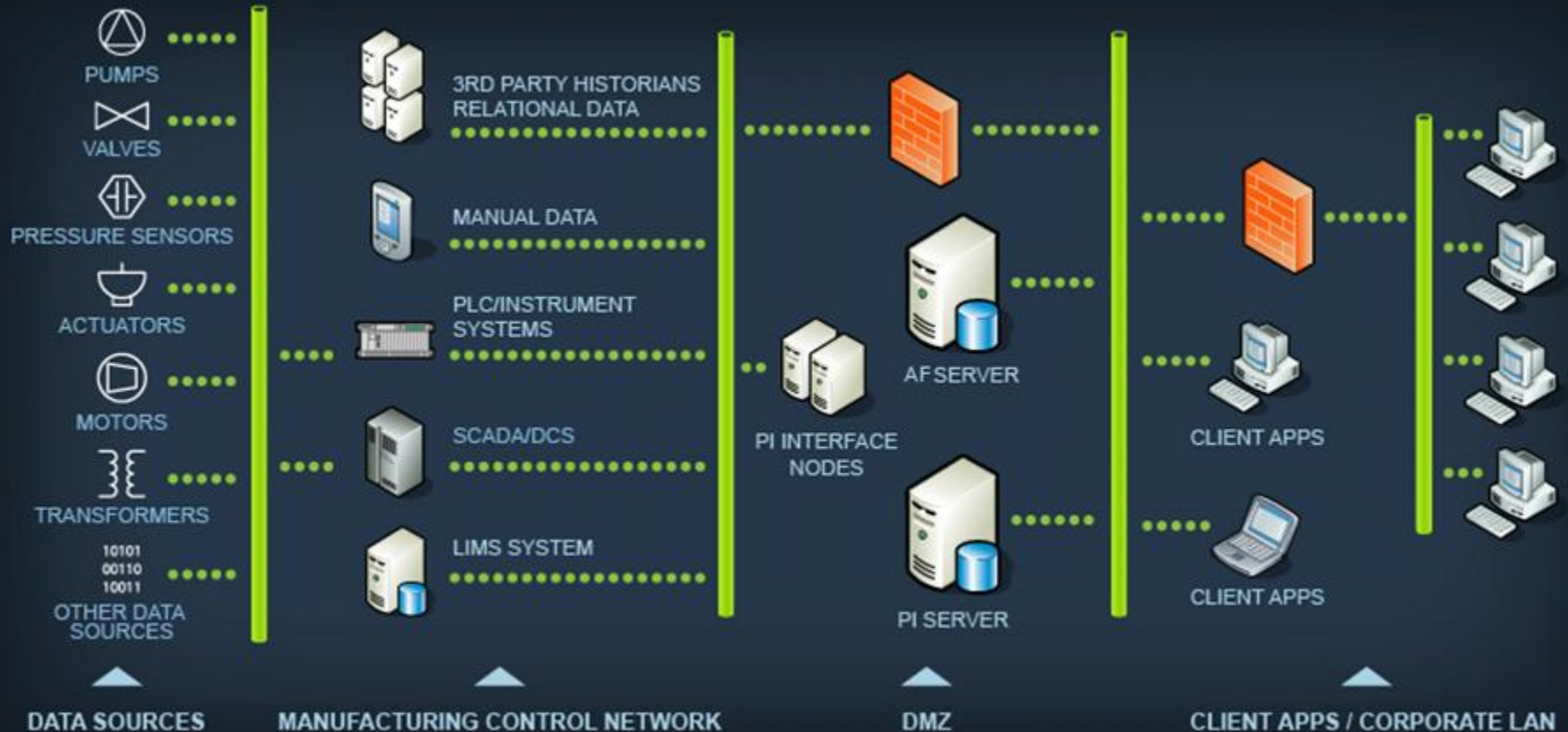


## Present

View data, identify problems, and take corrective action with familiar, easy-to-use graphical tools.

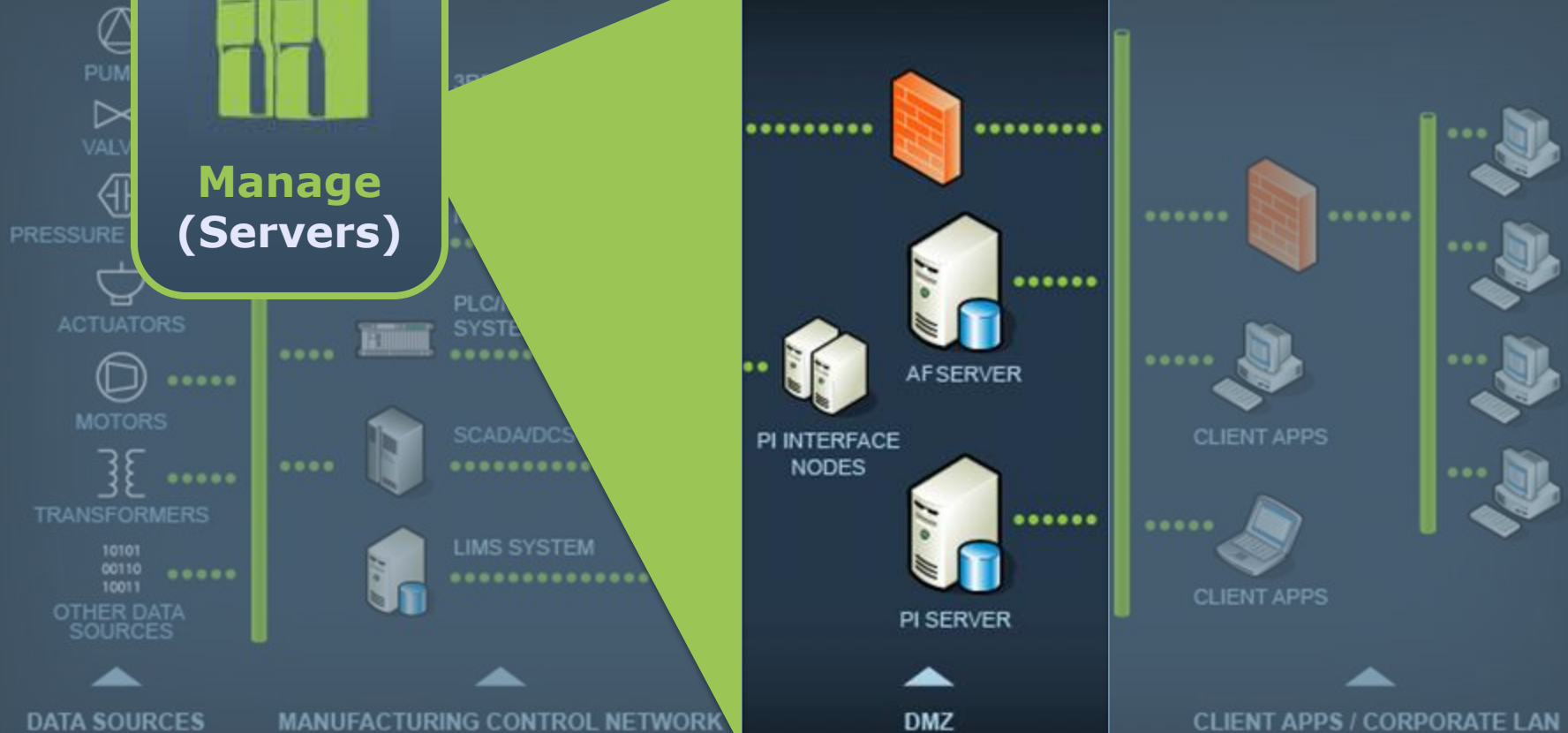
**Visuals**

# THE PI SYSTEM: ARCHITECTURE

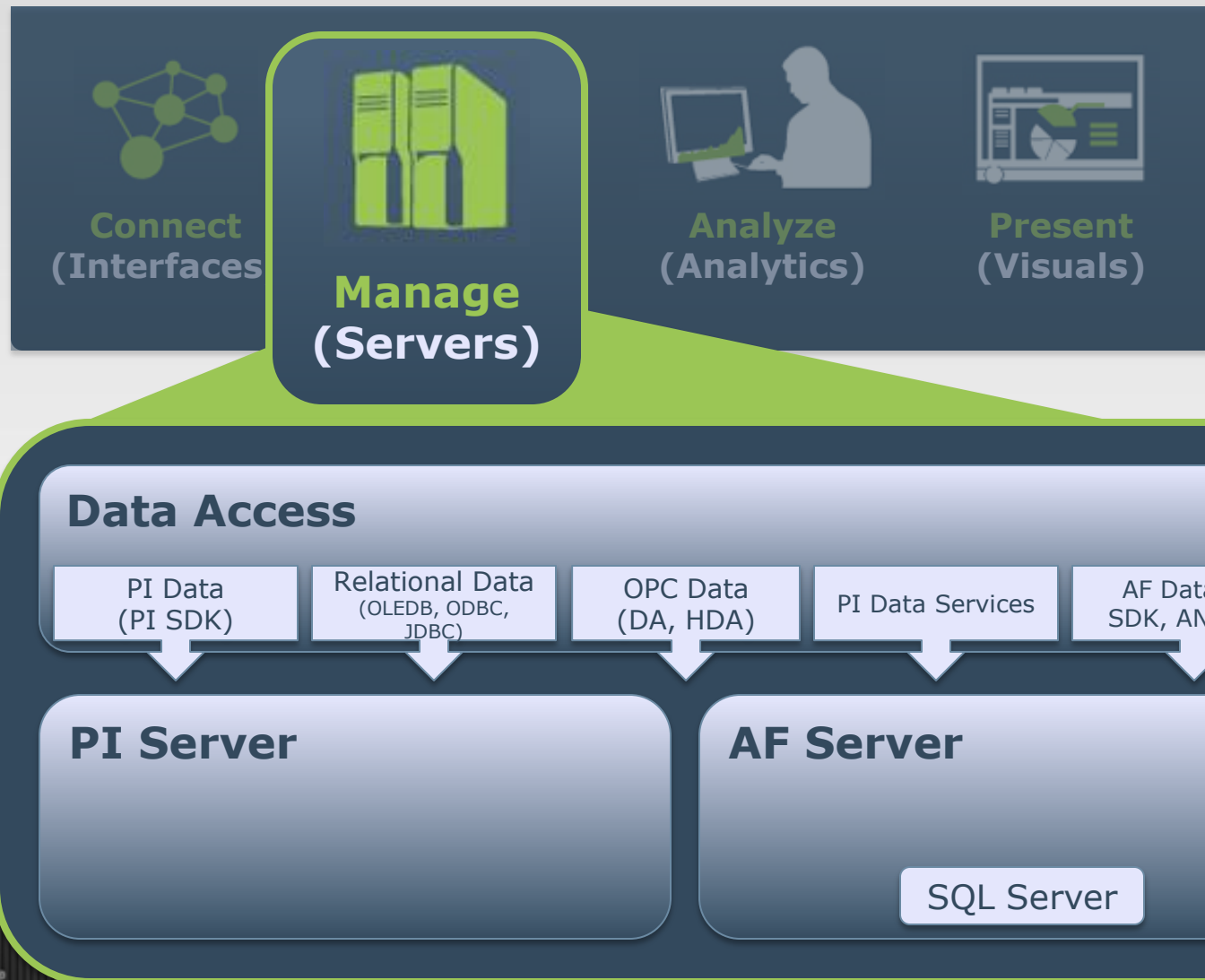


# THE PI SYSTEM: ARCHITECTURE

**Manage  
(Servers)**



# THE PI SYSTEM: MANAGE





# PI SERVER – THE BASICS

- Data Historian at the core of the PI System
  - Capable of storing and serving masses of data in real time

---
- PI Points Database
  - PI Point (a.k.a. Tag): Object composed of attributes, representing a data stream
- PI Archives
  - Files containing the time series data associated to the points
- Other Databases (Security, Logs, etc.)

# PI SERVER - SIMPLIFIED

PI Points

Tag	Attrib1	Attrib2	AttribN
Data Stream1	...	...	...
Data Stream2	...	...	...

- Security
- Logs
- Etc.

Archives

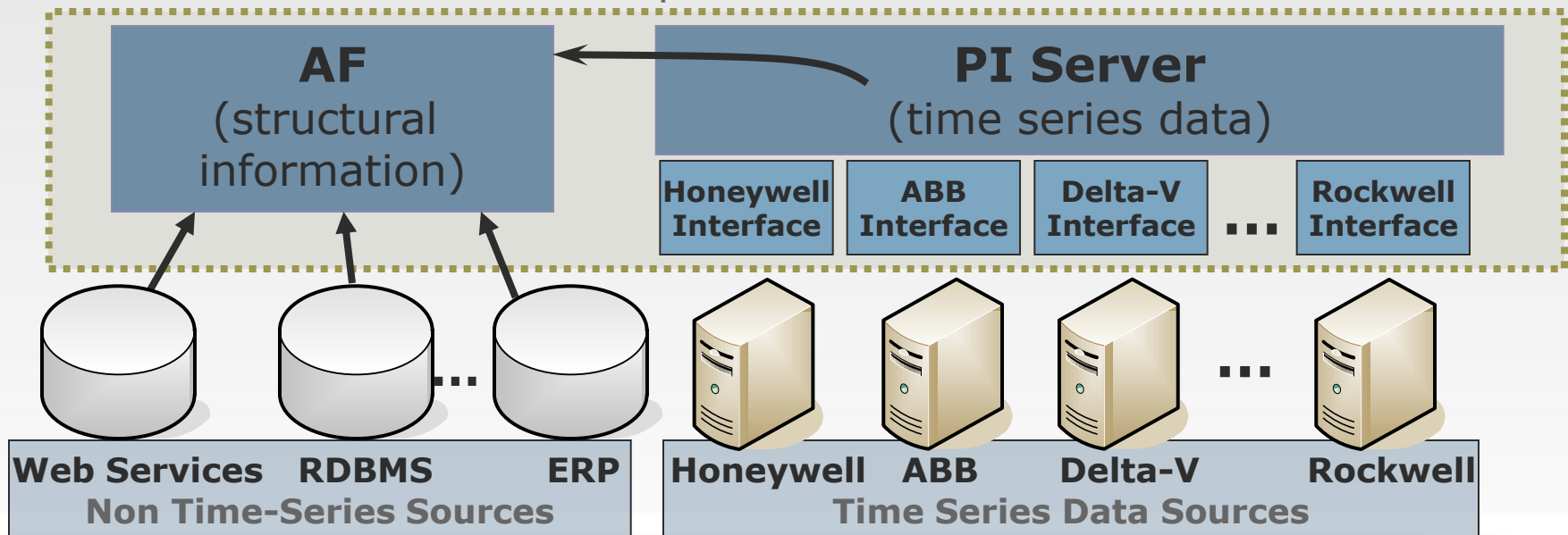
Tag	Time	Value
Data Stream1	t1	v1
Data Stream1	t2	v2
Data Stream2	t1	v1
Data Stream2	t2	v2

# MORE INFORMATION ON THE PI SERVER

- PI System Manager I: Essentials Skills
  - Instructor-led training (<http://training.osisoft.com>)
  - Online Course (vCampus Training Center)
- Documentation on vCampus Library
  - vCampus PI Products Kit > Server Products > PI Server
- PI Admin and End-User type questions:
  - Technical Support
    - [techsupport@osisoft.com](mailto:techsupport@osisoft.com)
    - 1-510-297-5828
- Programming and Integration questions: vCampus

# AF

- Application/Abstraction layer on top of PI
- Significantly changes how to view and use PI:
  - Tag-centric → Asset-centric
  - Flat → Hierarchical
  - Unstructured → Organized
  - Server-centric → Enterprise-wide



# IS AF JUST "A MORE ORGANIZED PI"?

No 😊

- Allows for better and even broader data aggregation:
  - PI Points and their data
  - Relational databases
  - Web services
  - Custom data sources
  - UoMs
  - Contacts
  - Relationships and modeling
- Base building block for visualization, analysis, notification and other engines

# AF ELEMENTS

- Database > Element > Attribute (+ Data Reference)

The screenshot displays the 'Assets - PI System Explorer' application. The left sidebar shows a tree view of elements, with '12-16-32-24W4' selected under the 'Green Site' category. The main pane shows the 'Attributes' tab for this element, listing various dynamic and static information. The right pane shows the 'Data References' section.

**Elements**

- Alberta
  - Black Site
  - Blue Site
  - Brown Site
  - Gray Site
  - Green Site
    - 12-16-32-24W4
    - 16-16-32-24W4
    - 2-16-32-24W4
    - 5-16-32-24W4
  - Orange Site
  - Purple Site
  - White Site
  - Yellow Site
- British Columbia
- North West Territories
- Yukon Territory

**12-16-32-24W4**

General | Child Elements | **Attributes** | Ports | Version

12-16-32-24W4 Group by: ☒ Category

Search

Name	Value
<b>Dynamic Information</b>	
Bottom Hole Pressure	10000 kPa
Condensate Flow Rate	74.10737 m3/d
Gas Flow Rate	1879.986 m3/d
Gas/Water Ratio	40.21386 %
Last Work-Over	Acid Wash - May 25 2007
Next Work-Over	Pump Change-Out - Feb 2 2008
Water Flow Rate	5.982141 m3/h
Well Head Pressure	878.0282 kPa
Well Head Temperature	60.14537 °C
<b>Static Information</b>	
Casing Diameter	7.5 in
Depth	2200 m
Location	12-16-32-24W4
On-Production Date	13/03/1997 12:00:00 AM
Tubing Diameter	4.5 in
Type	Vertical

**Data References**

Search

- Formula
- Intermediate/Variable
- PI Point
- PI Point Array
- Table Lookup

Bottom Hole Pressure

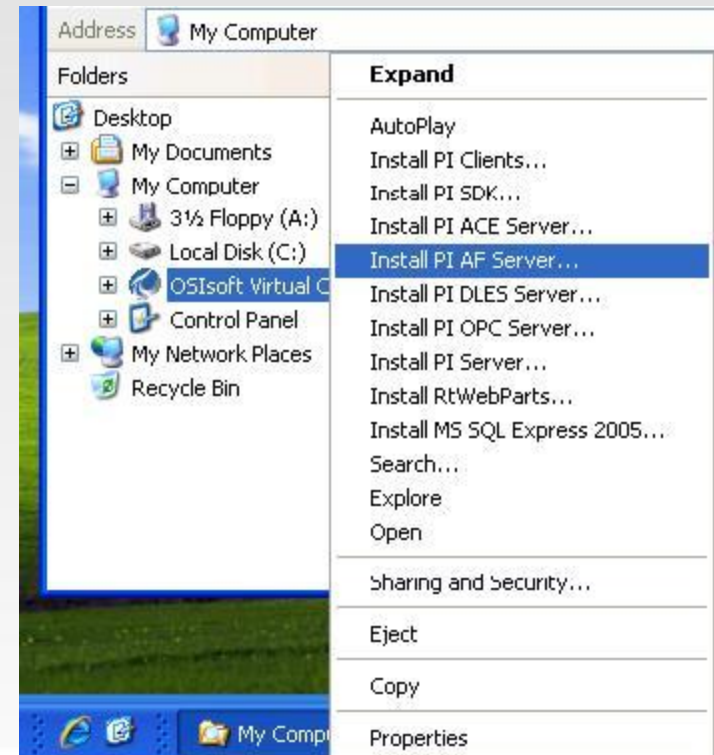
# OTHER MAIN COMPONENTS

- Library
  - Element Templates
  - Tables (Linked or local)
  - Configuration Items
    - Categories
    - Enumeration Sets
    - Reference Types
- Unit of Measure (UoM)
- Contacts



# V-CAMPUS PI PRODUCTS KIT

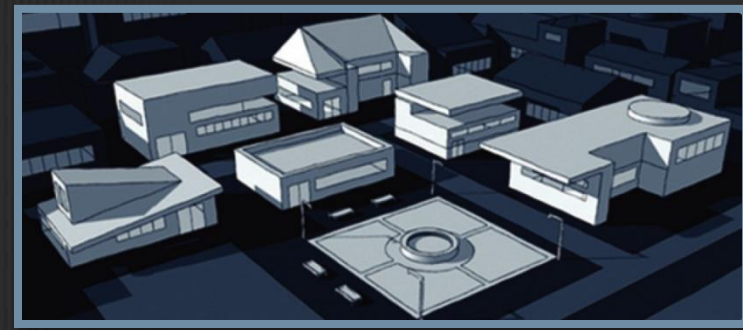
- Provided as a DVD Image on the vCampus Download Center
- Can burn on actual DVD or load it in a DVD emulation software (see webinar in Auditorium)
- Multiple installation options (explained in ReadMe.htm)





# PRODUCTS DELIVERED ON vCAMPUS

- **PI Server** Components
  - PI Server, PI ACE, PI AF, PI Notifications
    - Max Point Count: 10,000
    - Max Nodes in a Collective: 3 (1 Prim. + 2 Sec.)
- **PI Client** Components
  - PI PB, PI DL, PI DLES, PI WP, PItoPI Interface
- **PI Data Access** Technologies
  - PI SDK, AF SDK, PI OLEDB, PI OPC Server
- Other programming resources exclusive to vCampus



# PROGRAMMING WITH PI

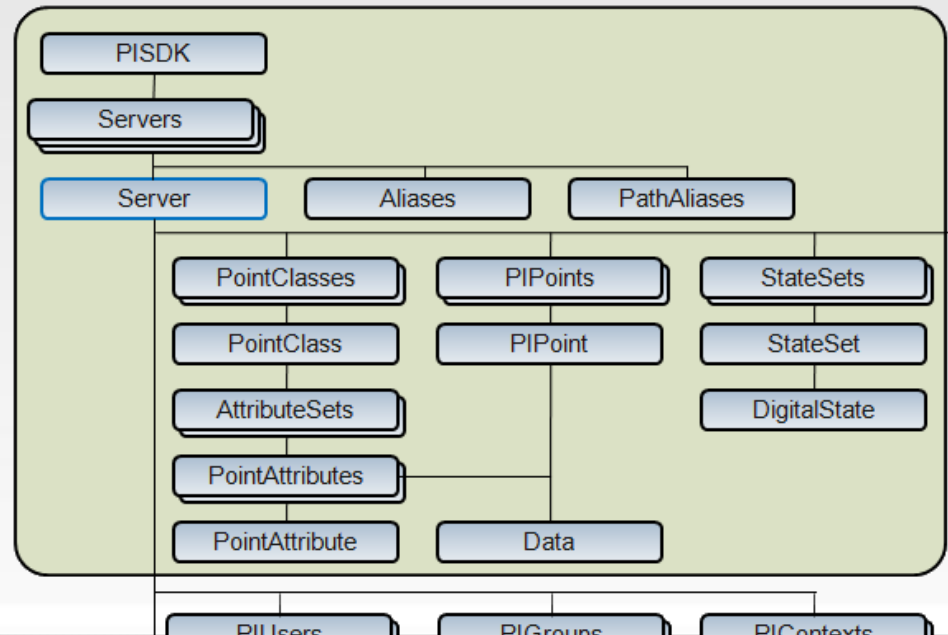
# THE CURRENT TOOLS

- The OSIssoft SDKs
- PI OLEDB Provider
- PI OPC DA/HDA Server
- PI ACE



# THE OSISOFT SDKS

- Proprietary technology, low-level
- Object oriented
- PI SDK → PI
- AF SDK → AF
- AN SDK → Notifications
- EF SDK → Event Frames (future)



# THE OSISOFT SDKS : WHY?

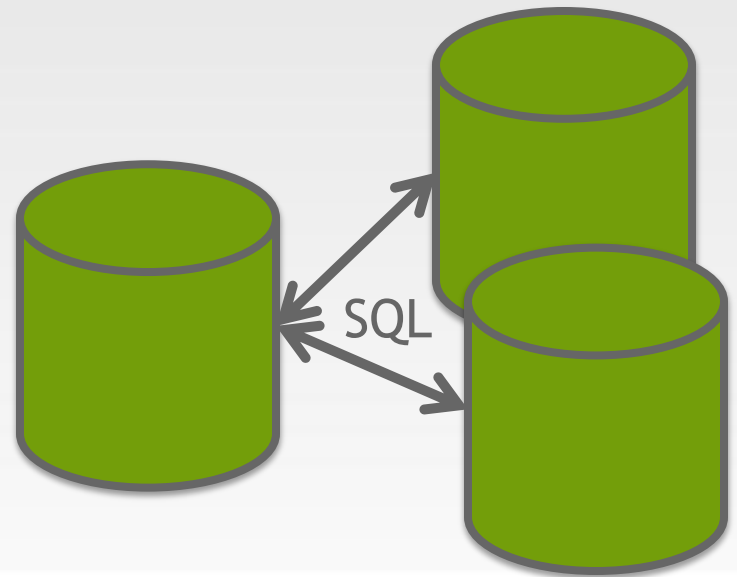
- Custom applications
  - Visualization
  - Manipulations
  - Calculations
  - Analyses
  - Reports

# PI OLEDB PROVIDER

- Standard protocol, high-level

## **SQL Queries + ADO[.NET]**

- PI Archives and PI Databases (read/write)



# PI OLEDB PROVIDER : WHY?

- Same reasons as SDK

+

- Linked Server (in MS SQL Server or other)
  - Easy integration of PI in your existing SQL apps
- Code-free environments:
  - SQL Server Reporting Services
  - SharePoint Business Data Catalog

# PI OPC DA/HDA SERVER

- Standard protocol, high-level

## **OPC Automation / OPC .NET API**

- PI Archives (read/write) and  
PI ModuleDB (read)





# PI OPC DA/HDA SERVER : WHY?

- Same reasons as SDK

+

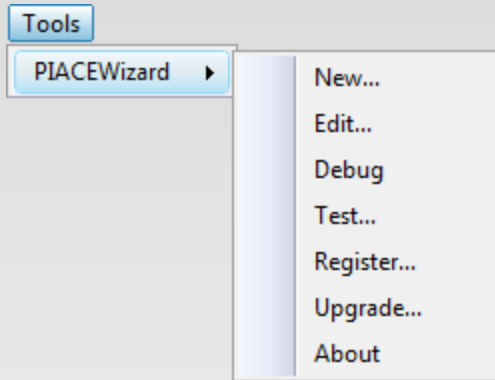
- Very popular for
  - Process optimization software
  - Calculation and analysis software
  - Visualization and reporting software

# PI ADVANCED COMPUTING ENGINE (ACE)

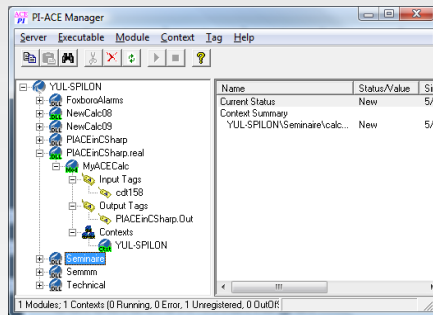
- Programming assistant
- Calculation scheduler
- Calculation manager
  - Recalculation



# PI ADVANCED COMPUTING ENGINE (ACE)



Wizard

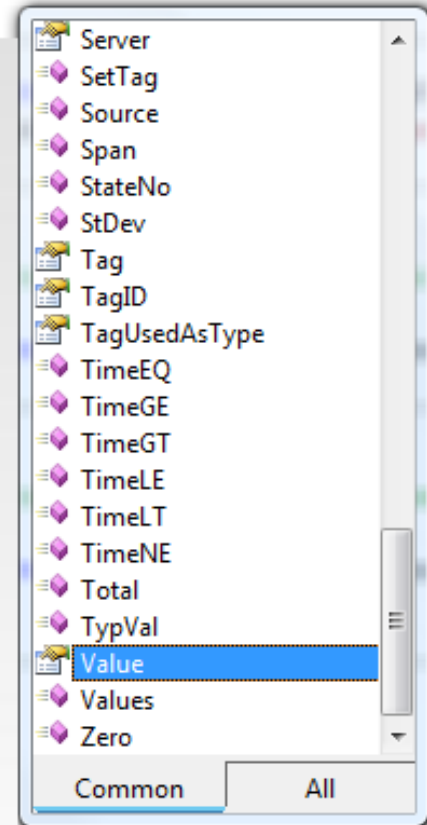


Manager



Scheduler

```
Public Overrides Sub ACECalculations()  
    sinusoid.  
End Sub
```

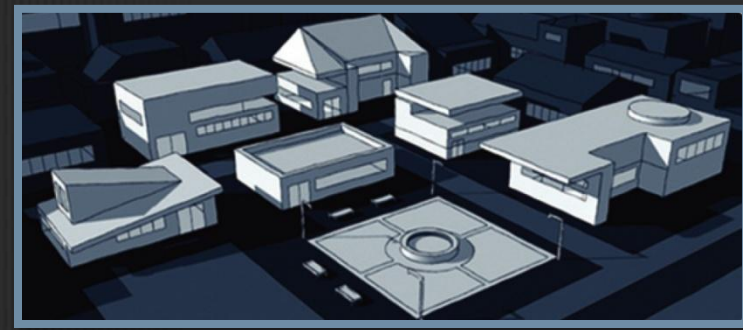


# PI ACE : WHY ?

- For seasoned developers, ACE provides:
  - Connection management
  - Schedule management
  - Buffering/Caching management
- For beginner developers, ACE represents:
  - Simple environment
  - Facilitated access to PI Points
  - Abstraction of some typical programming tasks

# MUCH MORE COMING IN 2009

- The OSIssoft SDKs
  - Will evolve to support other improvements in the various PI products
- Major releases in these areas:
  - PI as a relational database (SQL)
    - 64-bit OLEDB, JDBC, AF access
  - PI as an OPC server
    - OPC UA, AF access
  - PI via Web services



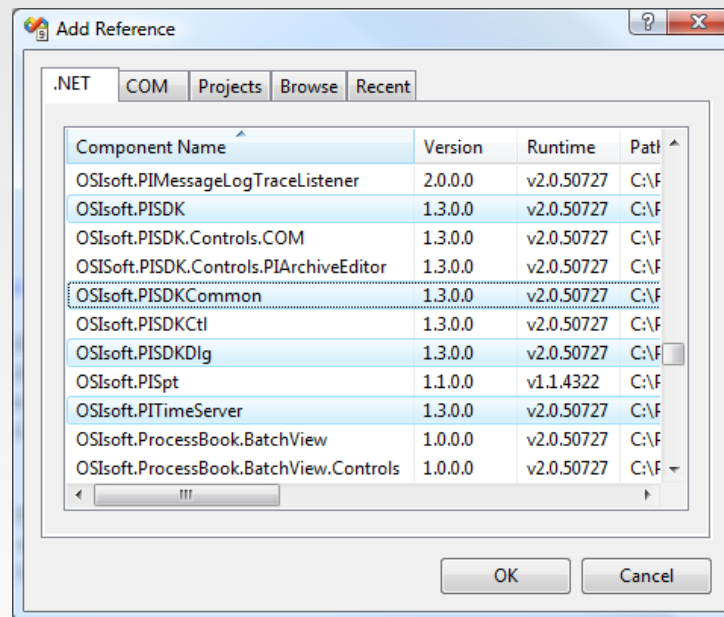
# THE OSISOFT SDKs

# THE OSISOFT SDKs

- PI SDK
  - PI Points (Attributes & Data)
  - PI Server Message Log
  - Various PI Databases (Users & Groups, etc.)
- AF SDK
  - AF Databases, Elements, Attributes
  - AF Analysis Rules (ARs) and Data References (DRs)
  - AF Connectivity Models and Cases
  - Notification Configuration (including Delivery Channel)
- Notifications SDK (a.k.a. AN SDK)
- Future: Event Frames SDK (a.k.a. EF SDK)

# PROGRAMMING WITH PI SDK

- Assemblies (installed in GAC – Global Assembly Cache)
  - OSIssoft.PISDK
  - OSIssoft.PISDKCommon
  - OSIssoft.PISDKDlg
  - OSIssoft.PITimeServer

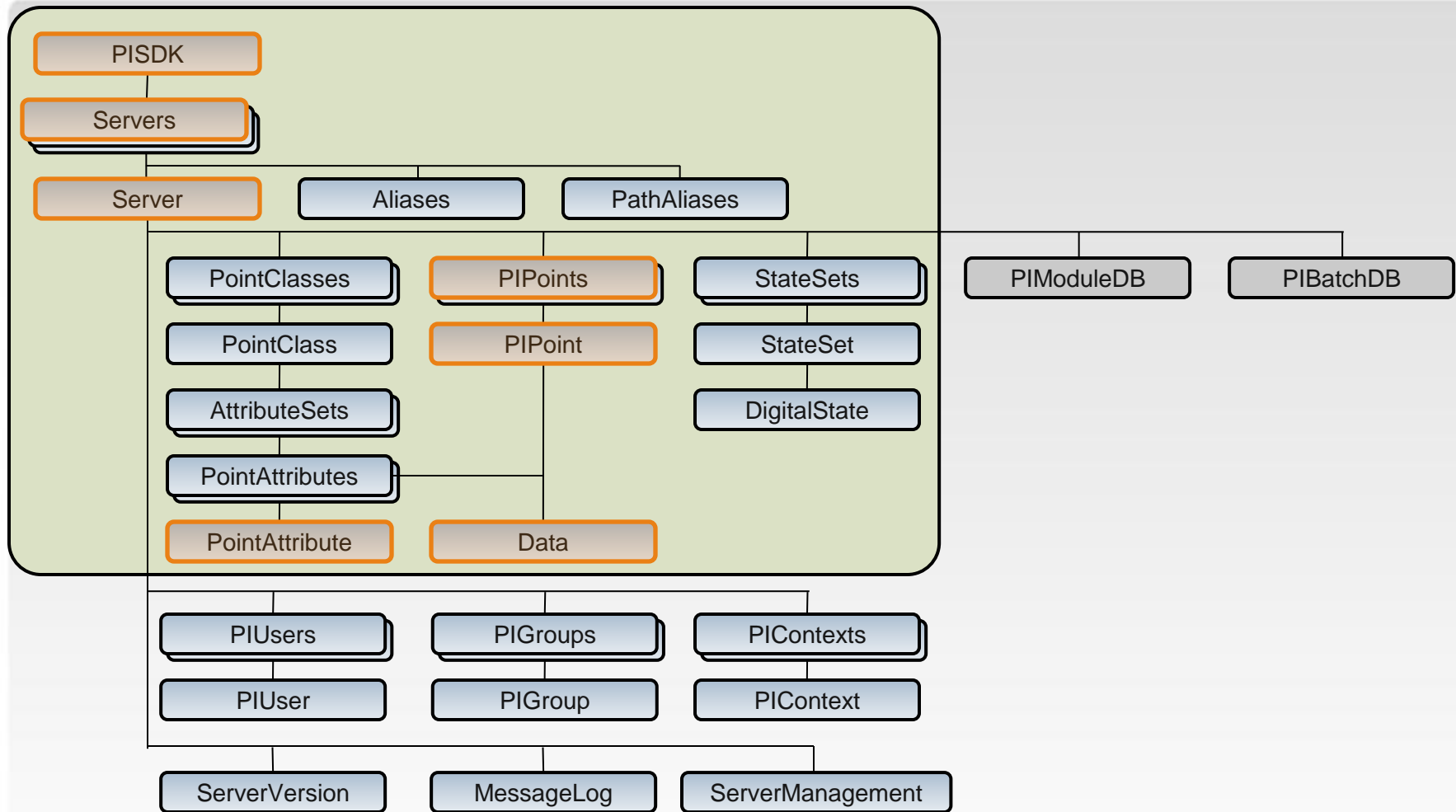




# PROGRAMMING WITH PI SDK

- Assemblies (installed in GAC – Global Assembly Cache)
    - OSisoft.PISDK
    - OSisoft.PISDKCommon
    - OSisoft.PISDKDlg
    - OSisoft.PITimeServer
  - Help File: \PIPC\Help\PISDK.CHM
- 
- Manage/Find PI Points
  - Read/Write Data
  - Perform Calculations
  - Invoke Common Dialog Windows
  - ...

# PI SDK OBJECT MODEL

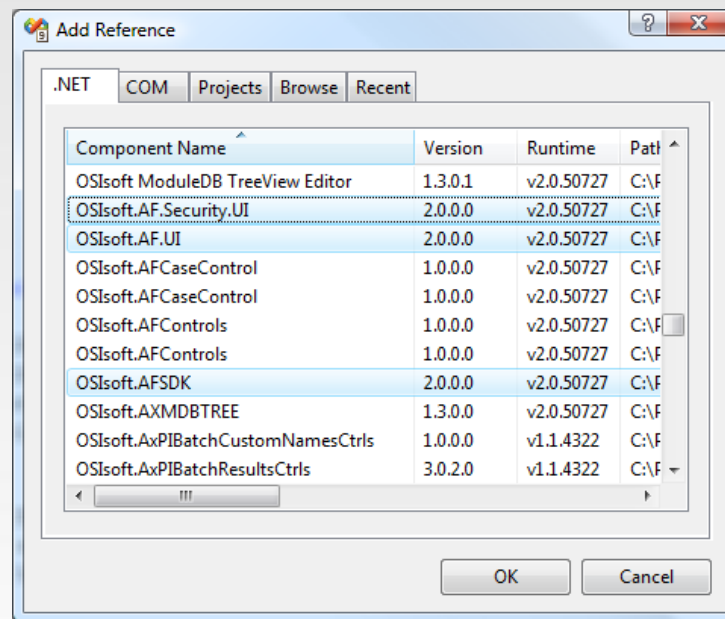


NOW SOME CODE!



# PROGRAMMING WITH AF SDK

- Assemblies (installed in GAC – Global Assembly Cache)
  - OSIssoft.AFSDK
  - OSIssoft.AF.UI
  - OSIssoft.AF.Security.UI

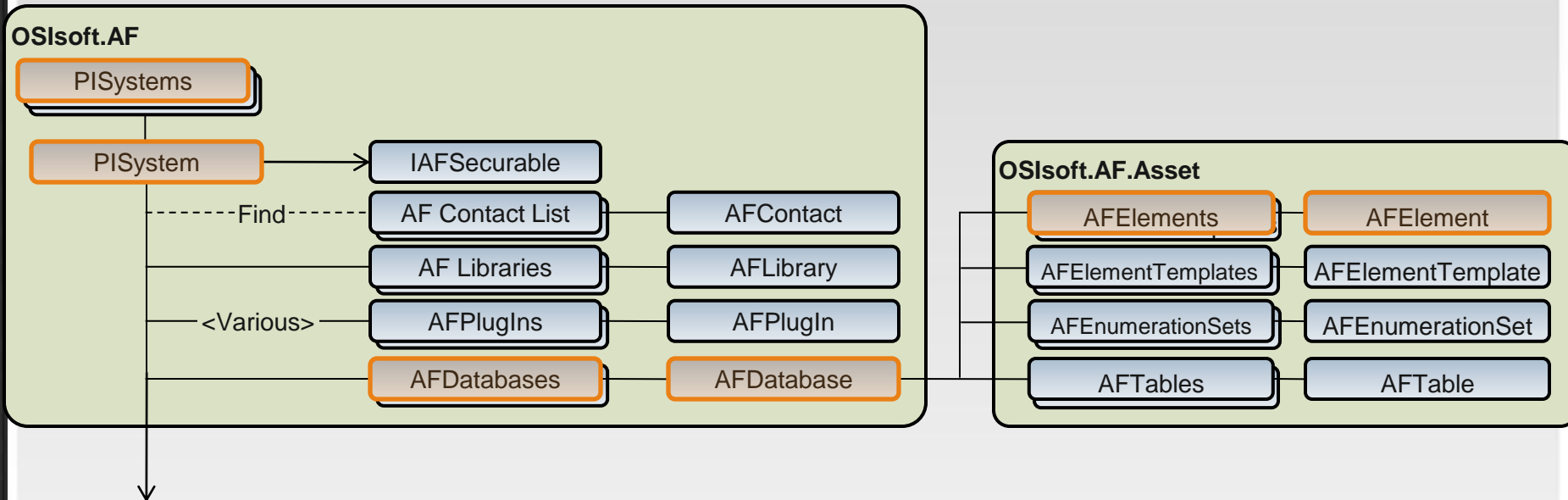


# PROGRAMMING WITH AF SDK

- Assemblies (installed in GAC – Global Assembly Cache)
    - OSisoft.AFSDK
    - OSisoft.AF.UI
    - OSisoft.AF.Security.UI
  - Help File: \PIPC\Help\AFSDK.CHM
- 

- Manage/Find Assets
  - Databases, Elements, Attributes
- Manage Library
  - Templates, Tables, Contacts
- Configure Notifications
- Invoke Common Dialog Windows
- ...

# AF SDK OBJECT MODEL

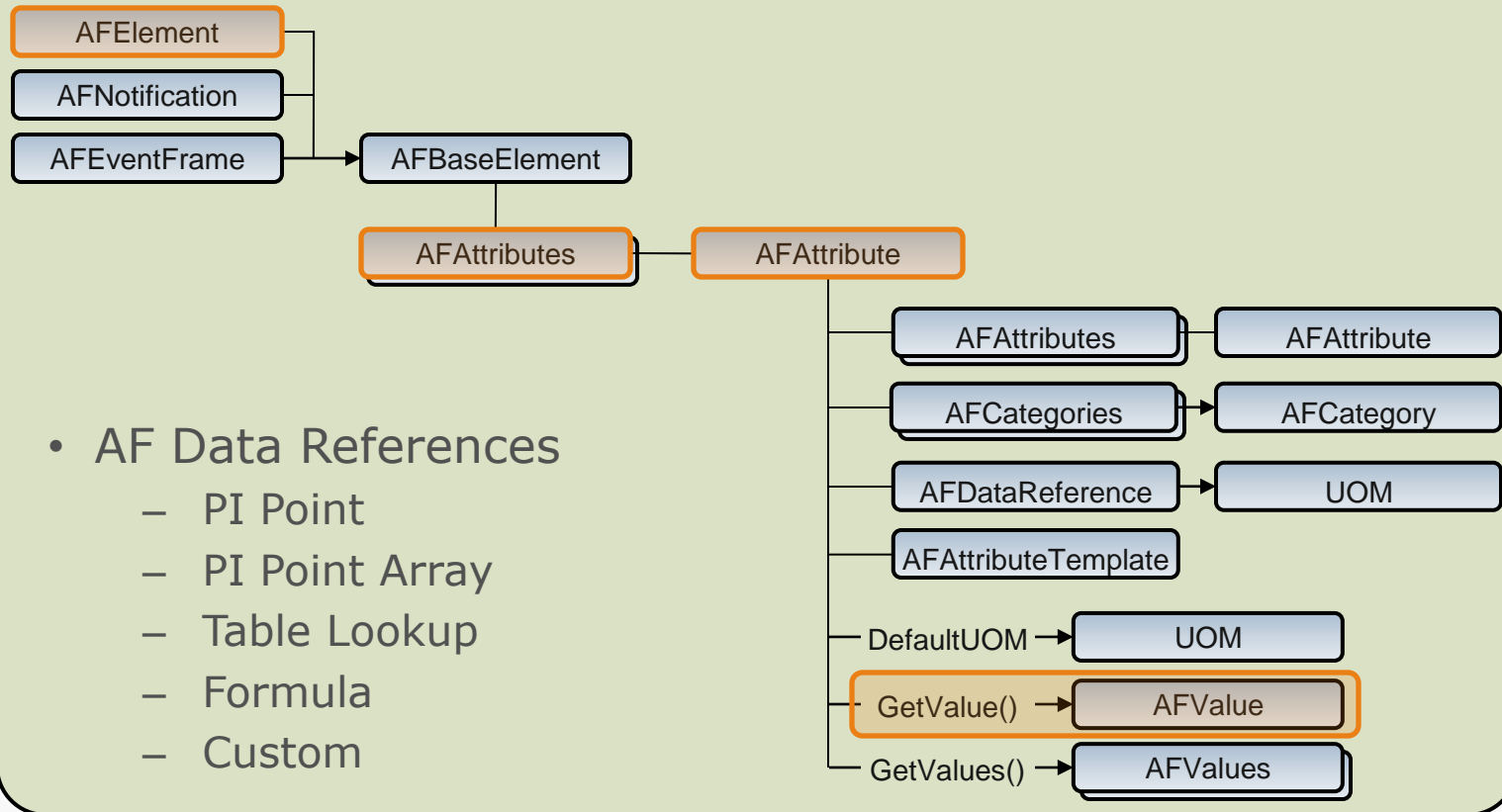


To other namespaces: AF. UnitsOfMeasure, AF.Analysis, AF.Modeling, etc.

- Sandbox/Check-in Mechanism on objects
  - .CheckIn(), .CheckOut(), .UndoCheckOut()
  - .CheckOutInfo

# AF SDK OBJECT MODEL (CONTINUED)

## OSIsoft.AF.Asset



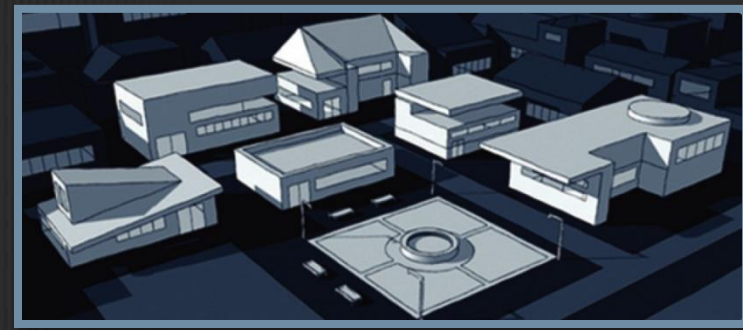
NOW SOME CODE!





# AF AND NOTIFICATIONS DEVELOPER TOOLS

- vCampus-exclusive kits providing:
  - AF SDK and AN SDK Programming References
  - VB.NET and C# Sample Code
  - Improved Microsoft Visual Studio experience
    - More exhaustive IntelliSense
    - More detailed Object Browser
- Watch vCampus Webinar held on January 29th



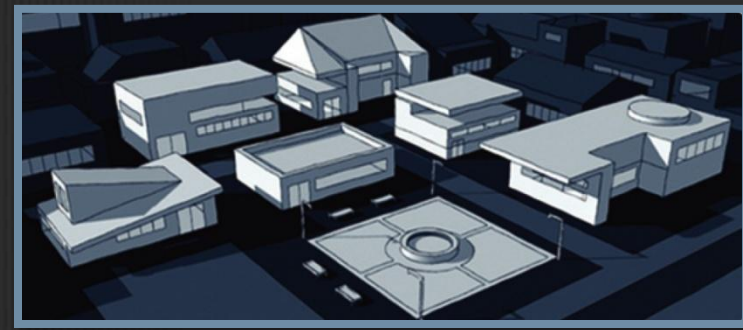
# PI OLEDB PROVIDER

# PI OLEDB PROVIDER

- Client-side "SQL/OLEDB to PI" engine
- Exposes PI Servers as relational databases
  - Access and manipulate PI data and objects using SQL statements
- Typically used in conjunction with ADO.NET and code-free environments
- PI Archives and DBs → Tables grouped in Catalogs
  - Ex: PIArchive.PIComp, PIPoint.Classic

NOW SOME CODE!





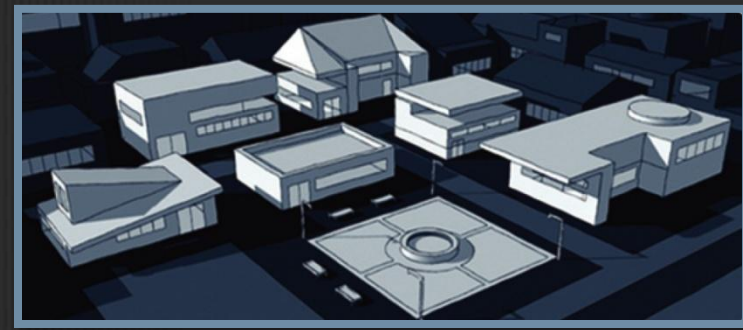
# PI OPC DA/HDA SERVER

# PI OPC DA/HDA SERVER

- Exposes PI Servers as OPC Servers
- Complies with OPC DA and OPC HDA Specifications
  - OPC Foundation ([www.opcfoundation.org](http://www.opcfoundation.org))
- Typically used with OPC Automation or OPC .NET API (from the OPC Foundation)
- PI Points, Aliases and Properties exposed as Item IDs
  - Ex: \\PIServer\cdt158
- Watch vCampus Webinar held on March 26<sup>th</sup>

NOW SOME CODE!





# CONCLUSION



# CONCLUSIONS

- Various data access technologies for various needs and environments
  - SDKs
  - OLEDB
  - OPC DA/HDA
  - More coming in 2009 (JDBC, OPC UA, Web Services)
- Don't forget PI ACE
  - Significant advantages even for seasoned developers
- Use the vCampus forums for help

# ADDITIONAL RESOURCES

- Recorded vCampus Webinars
  - [29-Jan-09] Tour of the AF and PI Notifications Developer Tools
  - [26-Mar-09] OPC – Past, Present and Future
- Instructor-led Training
  - PI ACE (also available as an online course)
  - Accessing PI as a Relational Database or as an OPC Server
  - New "boot camp" type training coming in Fall 2009
- vCampus Library (guides, references, etc.)
- vCampus Discussion Forums


# VCAMPUS-EXCLUSIVE WEBINARS

- The "Builders' Café" Webinar Series
- Submit your ideas here:


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# NEXT vCAMPUS WEBINARS



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AUDITORIUM

## Recorded Webinars

**Builders' Café Webinar Series: Tour of the AF and PI Notifications Developer Tools** by Steve Pilon [Thu, Jan 29 2009]

This is the recording for the vCampus-exclusive webinar titled "**Tour of the AF and PI Notifications Developer Tools**" (part of the "**Builders' Café**" webinar series). This was held on January 29th, 2009.

The webinar first gives an introduction on 2 OSIsoft products (AF and PI Notifications) and then covers 2 great resource kits available to developers via the vCampus program: AF Developer Tools and PI Notifications Developer tools.

Make sure you watch it until the end: we had a great Question and Answers (**Q&A**) session where the 2 lead developers and the product manager were personally answering questions from the attendance. Speakers were:

- Steve Pilon, vCampus Team Member
- Laurent Garrigues, Product Manager at OSIsoft
- Chris Manhard, Lead Developer for PI AF
- Beth McNeill, Lead Developer for PI Notifications

**Builders' Café Webinar Series: Foreword and Introductions** by Steve Pilon [Mon, Dec 22 2008]

This is the recording for the first webinar in the vCampus-exclusive "**Builders' Café**" webinar series. It is titled "**Foreword and Introductions**" and was held on December 18th, 2008.

The webinar covers the basics of what vCampus is and contains, its goals, its guiding principles and the team working around it.

**How to use the vCampus DVD image (ISO file)** by Steve Pilon [Sun, Oct 26 2008]

## UPCOMING WEBINARS

### Builders' Café Webinar Series:

[26-Mar-09] OPC - Past, Present and Future  
(**Register now!**)

[30-Apr-09] Discoveries from UC2009  
(**Register now!**)

## SHORTCUTS

- Media Gallery Administration

## TAG CLOUD

Builders' Café Webinar Series Daemon Tools

DVD emulation

## RSS FEED



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## RECENT WEBINARS



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3. [vCampus@osisoft.com](mailto:vCampus@osisoft.com)

## Q & A

- People **on conference call**:
  - All lines will be un-muted
  - Don't put us on hold!  
(or we'll hear music)
- People using **Internet audio**:
  - Type your questions in the LiveMeeting environment



## Q & A



People on conference call:  
•All lines will be **unmuted**