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Empowering Business in **Real Time.**

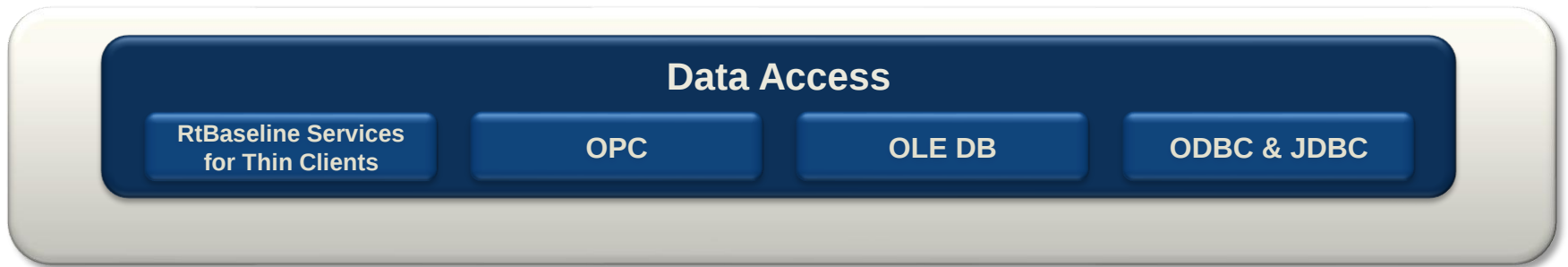
PI Infrastructure for the Enterprise.

Data Access

Ray Verhoeff
Bodo Bachmann

Agenda

- The data access “surface area”
 - PI AF & RtBaseline Services
 - OPC
 - SQL-based data access

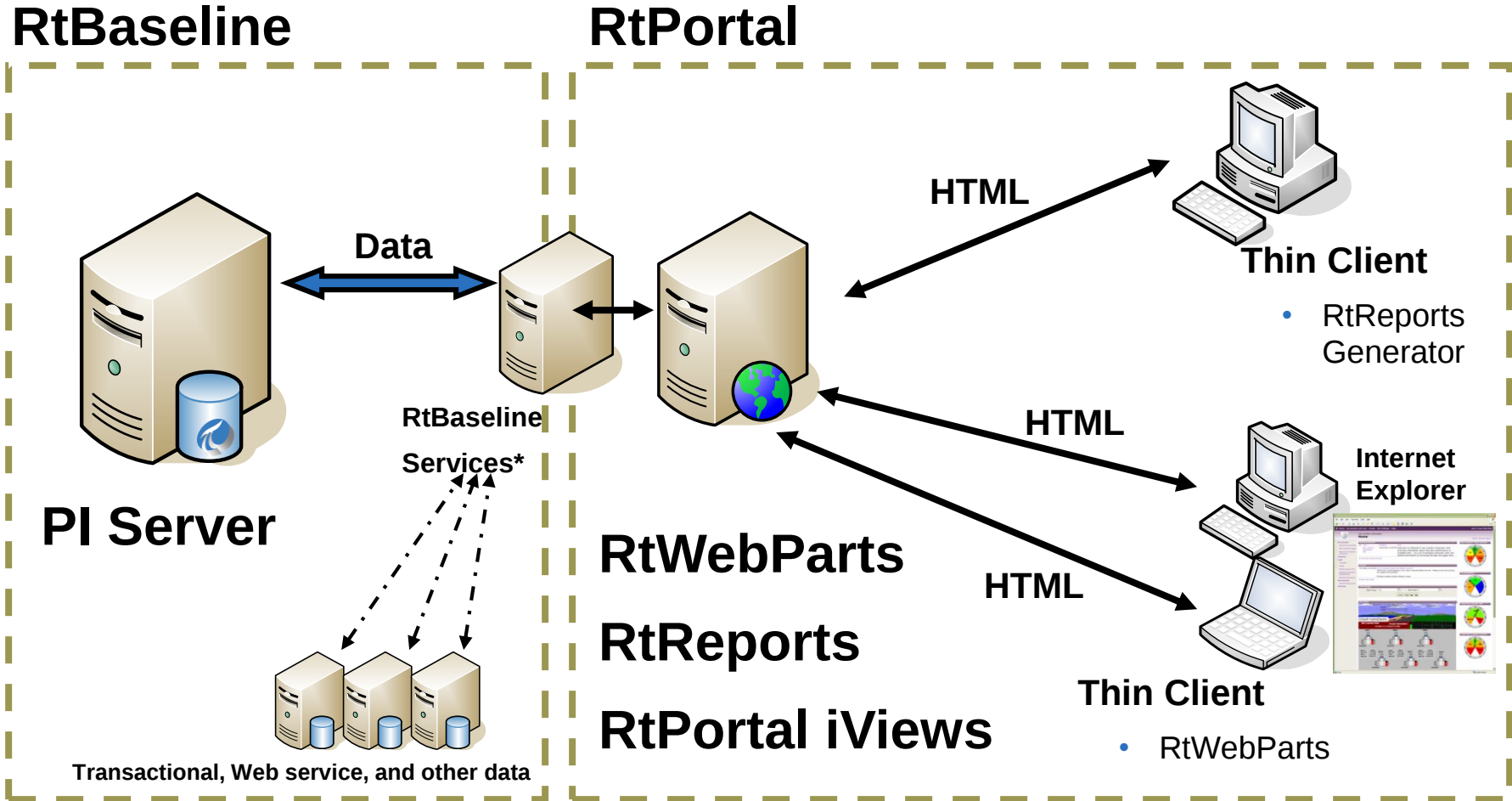


“Surface Area”

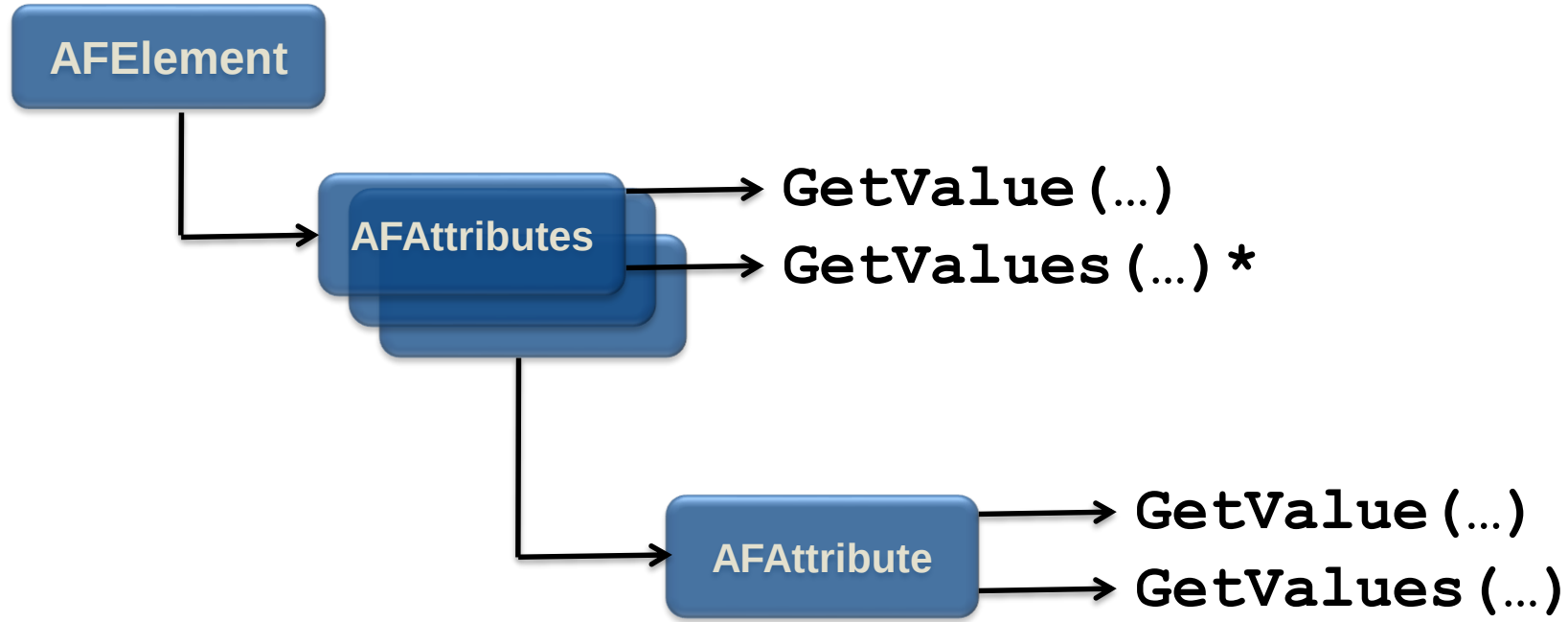
- Collection of all techniques for accessing all or part of the PI System
 - PI SDK
 - PI API*
 - AF SDK
 - Including AN SDK
 - OPC
 - Both COM-based and OPC UA
 - SQL-based access
 - OLE DB
 - ODBC
 - JDBC

RtBaseline Services

Data Access for OSIsoft Thin Client Applications



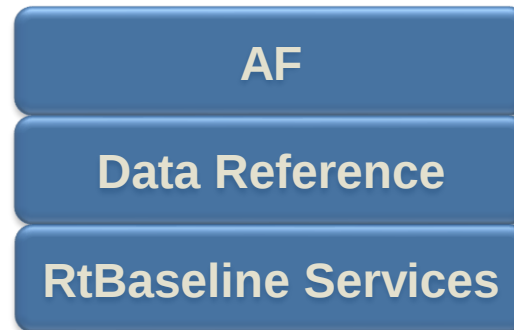
Data Access through the AF SDK



- ...and add Events

AF SDK Data Access with RtBLS

- RtBaseline provides:
 - Access to many data sources
 - Connection pooling
 - User session management
 - Data caching
- AF will use Data References based on RtBaseline Services



OSIsoft and OPC

- OPC COM-based standard
 - DA and HDA Servers
- What is the OPC Foundation doing next?
 - OPC Unified Architecture (UA)!

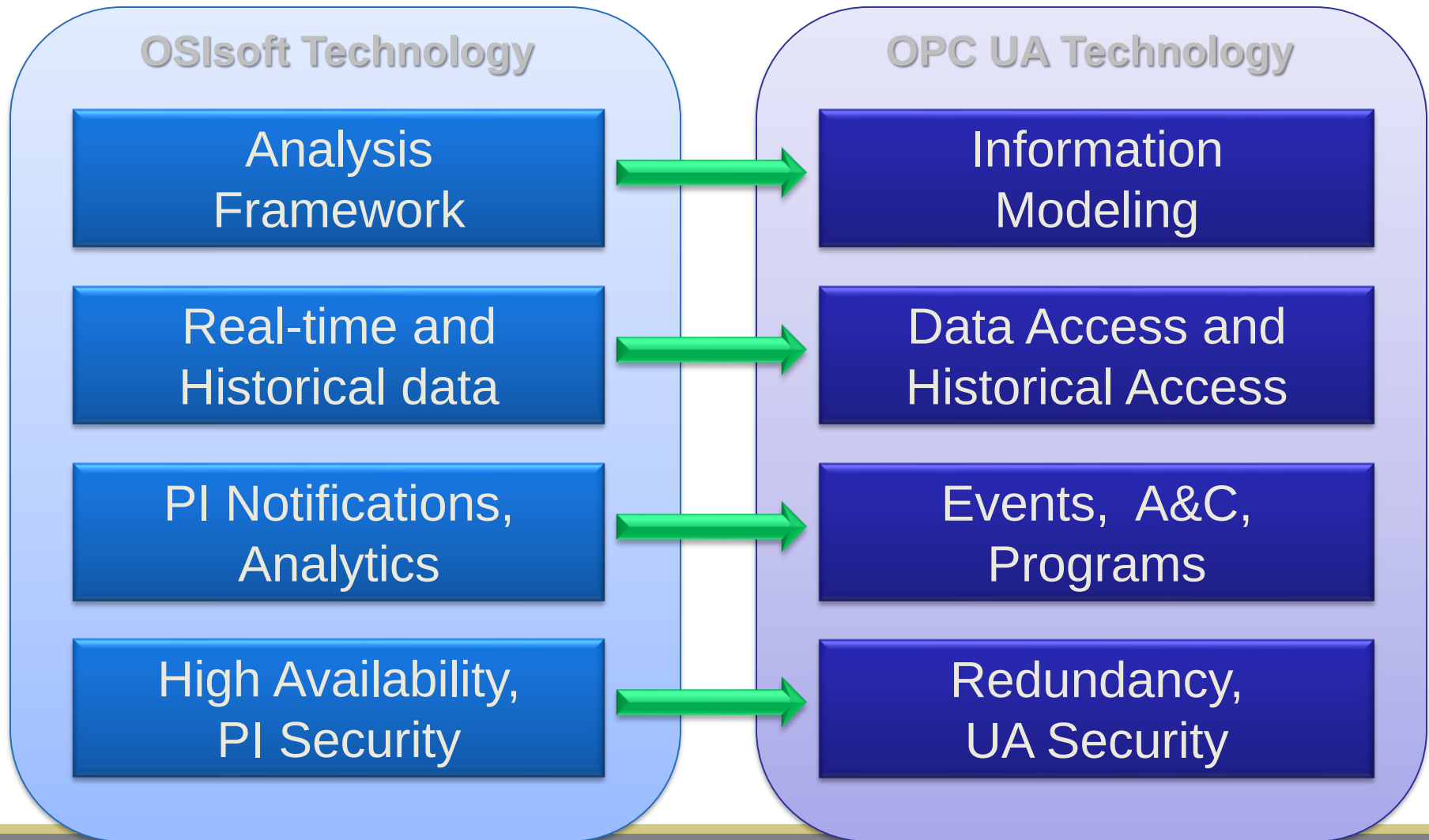
Why a new OPC architecture?

- Organize data around Nodes and Relationships
- Unified API for different classes of data access
- Browse & Search to aid in discovery
- Extensibility for supporting complex data structures
- Mitigate security threats
- Standards-based, flexible transport
 - Binary/TCP
 - XML/SOAP
- Cross-platform interoperability

OPC UA Address Space

- “Set of objects and relationships exposed by an OPC UA Server”
- Nodes:
 - Have Attributes, which have values
 - Minimum:
 - Node name
 - Node type
 - Node id
- All objects are nodes, not all nodes are objects

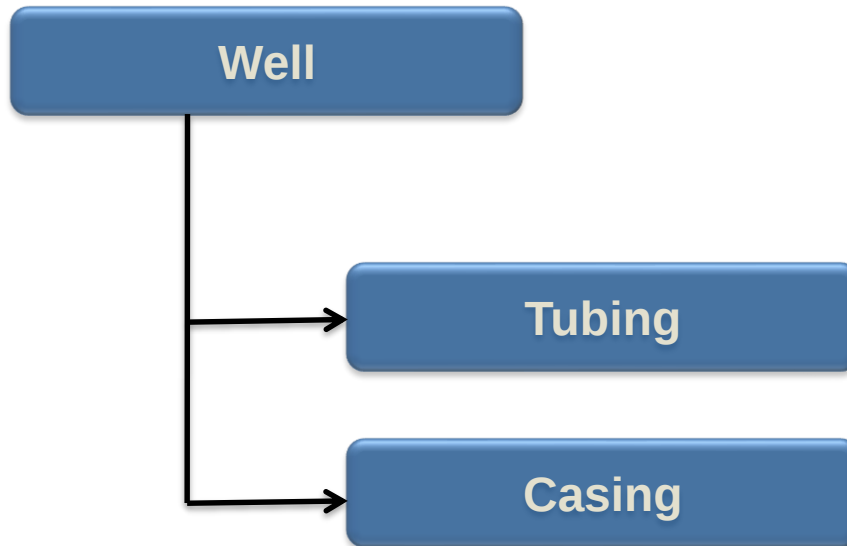
Mapping OSIsoft's Technology into OPC UA



OPC UA Information Model

- Definition:

- Specific design of Nodes and Relationships to support the data access requirements of an industry domain
- For example, in upstream oil & gas:



Collaboration and Partnership

- Collaboration with ISA (S88, S95, S99)
- Collaboration with MIMOSA
- Partnership with ISA
- Partnership with PRODML
- Collaboration with IEC
- Collaboration with OAGi
- Collaboration with EDDL
- Collaboration with FDT
- Collaboration with PLCOpen
- Partnership/Collaboration with automation.com
- Collaboration with MS MUG & NAMUR
- Partnership with OPCconnect.com

OPC UA Security

- Client and Server hold X.509 v3 Certificates
- How they are obtained is not defined by UA
- GetSecurityPolicies to exchange certificates
- RequestSecurityToken to create secure session

OPC UA Security

- Requirements
 - authentication
 - integrity
 - confidentiality
 - authorization
 - non-repudiation
 - availability

OPC UA Security Threat Types

- Message flooding
- Eavesdropping
- Message spoofing
- Message alteration
- Message replay
- Malformed messages
- Server profiling
- Session hijacking
- Rogue Client or Server
- Compromising user credentials

OPC UA Transport Profiles

UA Stack Profiles:

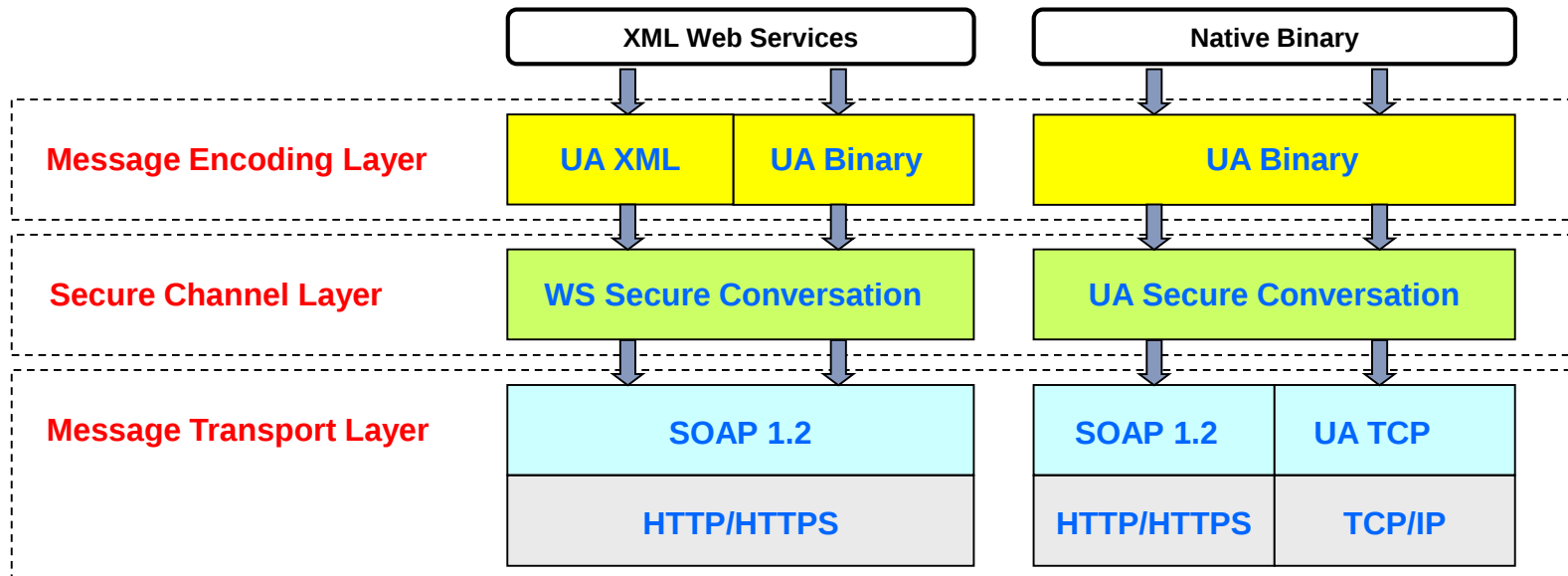
1. XML Web Service (XML or UA Binary)
2. Native Binary (UA Binary, UA Secure Conversation, UA TCP)
3. Native Binary with SOAP/HTTP

Message Encoding:

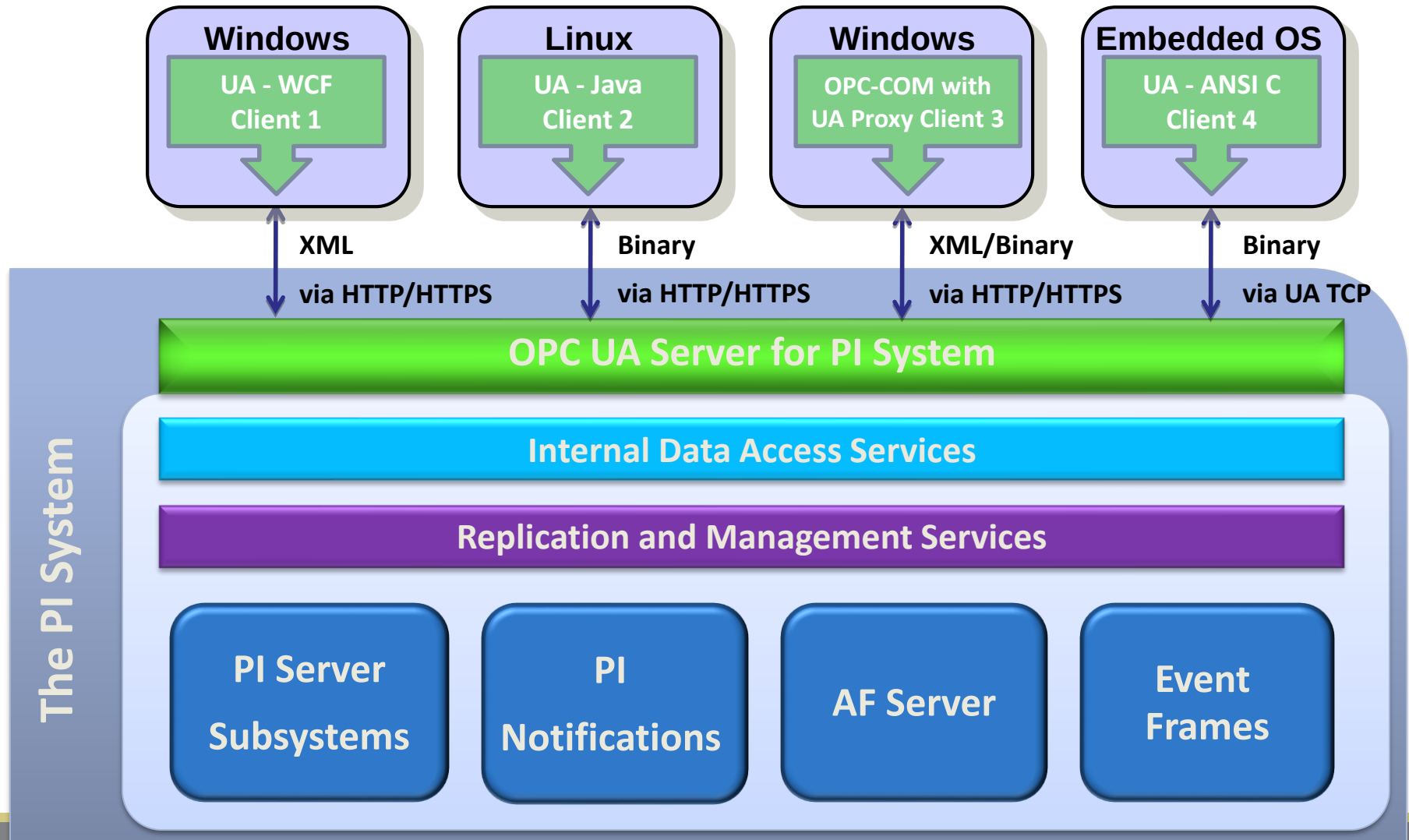
1. UA XML = XML Schema + WSDL
2. UA Binary = OPC Binary Schema

Transport:

1. HTTP/HTTPS
2. TCP/IP



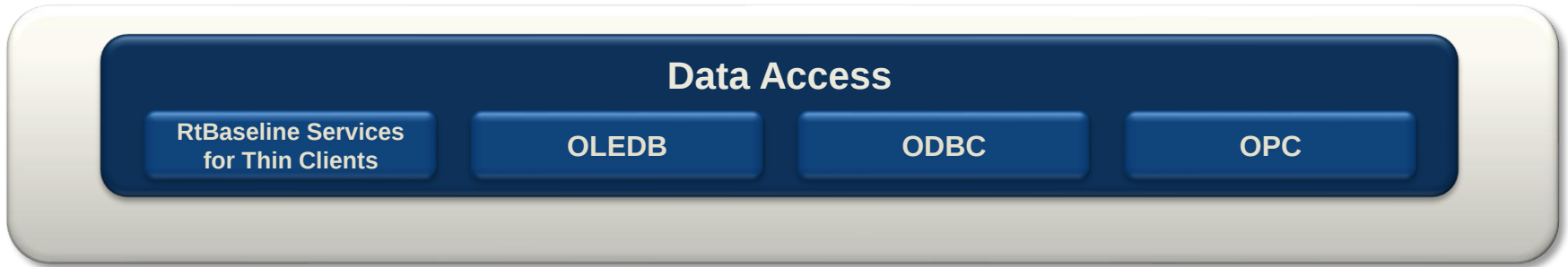
OPC UA Server for PI System



SQL based Data Access

Data Access - Overview

PI Data is available via common standards

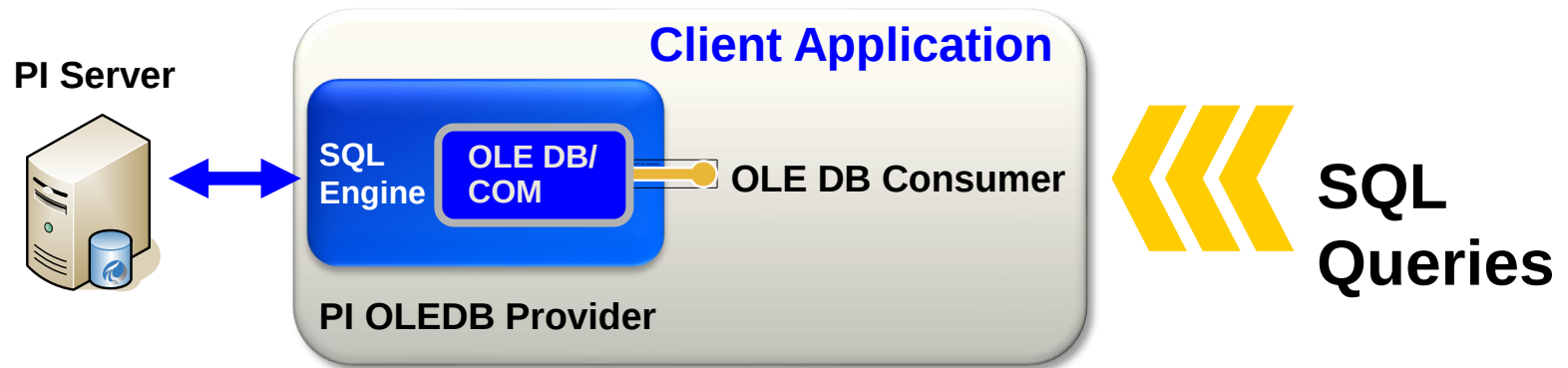


- WebServices (i.e. RtBaseline Services) – Provide Data to Web Applications
- OLEDB – Data Access via SQL Queries
- ODBC – Data Access via SQL Queries
- OPC DA/HDA/UA – Data Access to the PI System via OPC Standard

Data Access

Via PI OLEDB

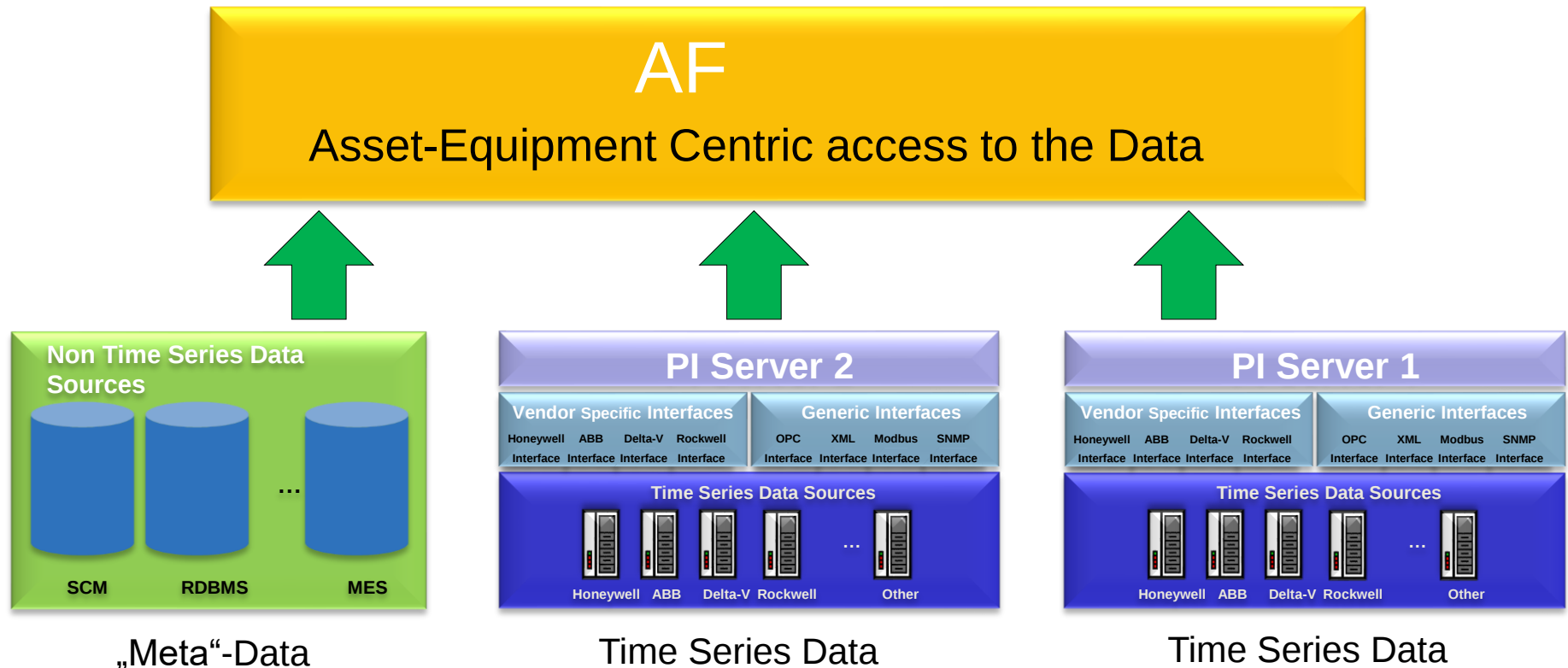
- PI OLEDB provider allows applications (OLE DB consumers) working with PI data through SQL queries:



- renew PI OLEDB Architecture
- introduce JDBC
- support „PI System“

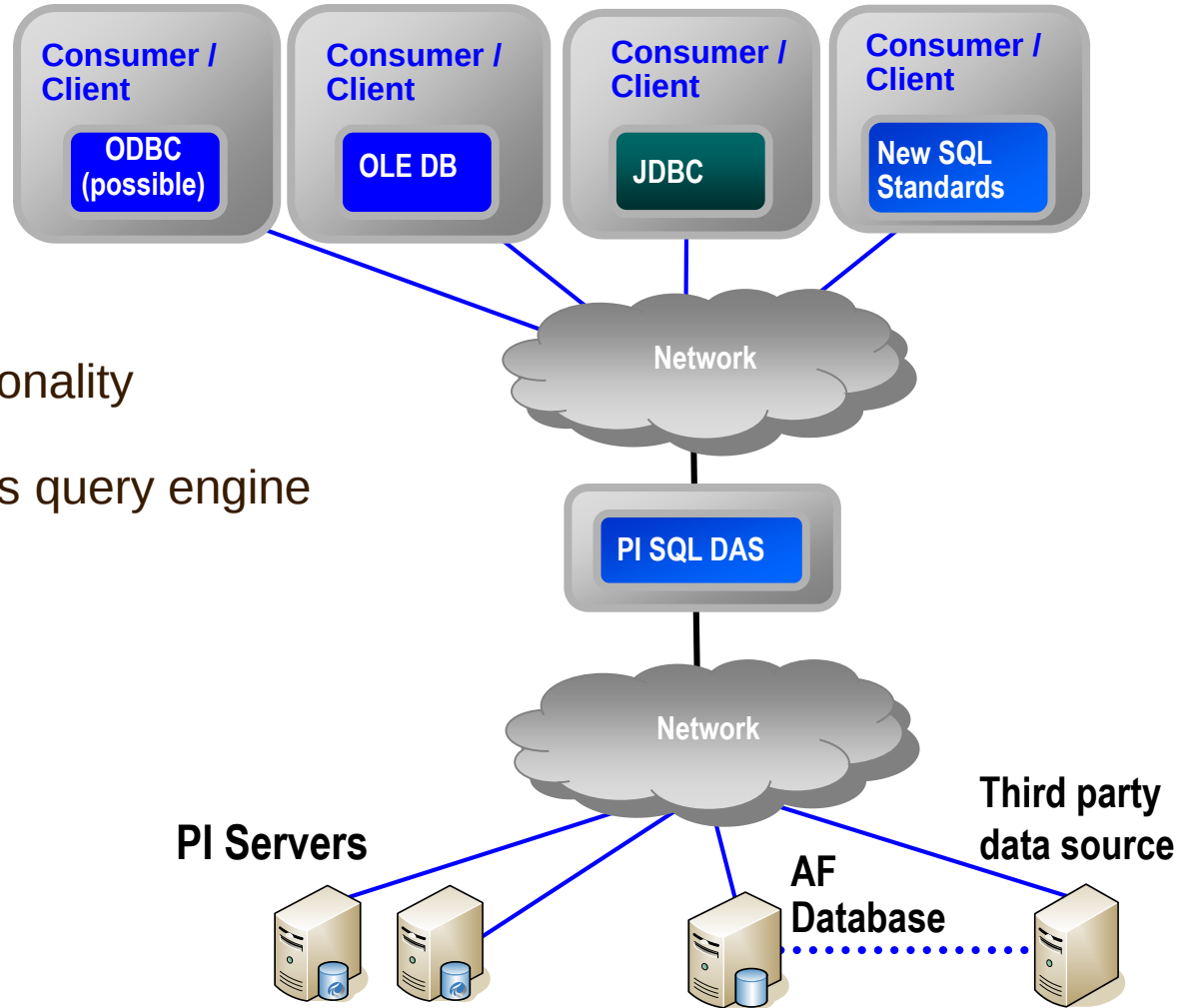
AF in the PI System

- Data structured and organized by Assets
- Spans multiple PI Systems
- Incorporates non time series Data



New Architecture

- Multi-standard and multi-platform architecture
One connection allows querying multiple data sources
- Standard implementation separated from SQL functionality
- Prepared for heterogeneous query engine



New Resource Management

- **Paging**

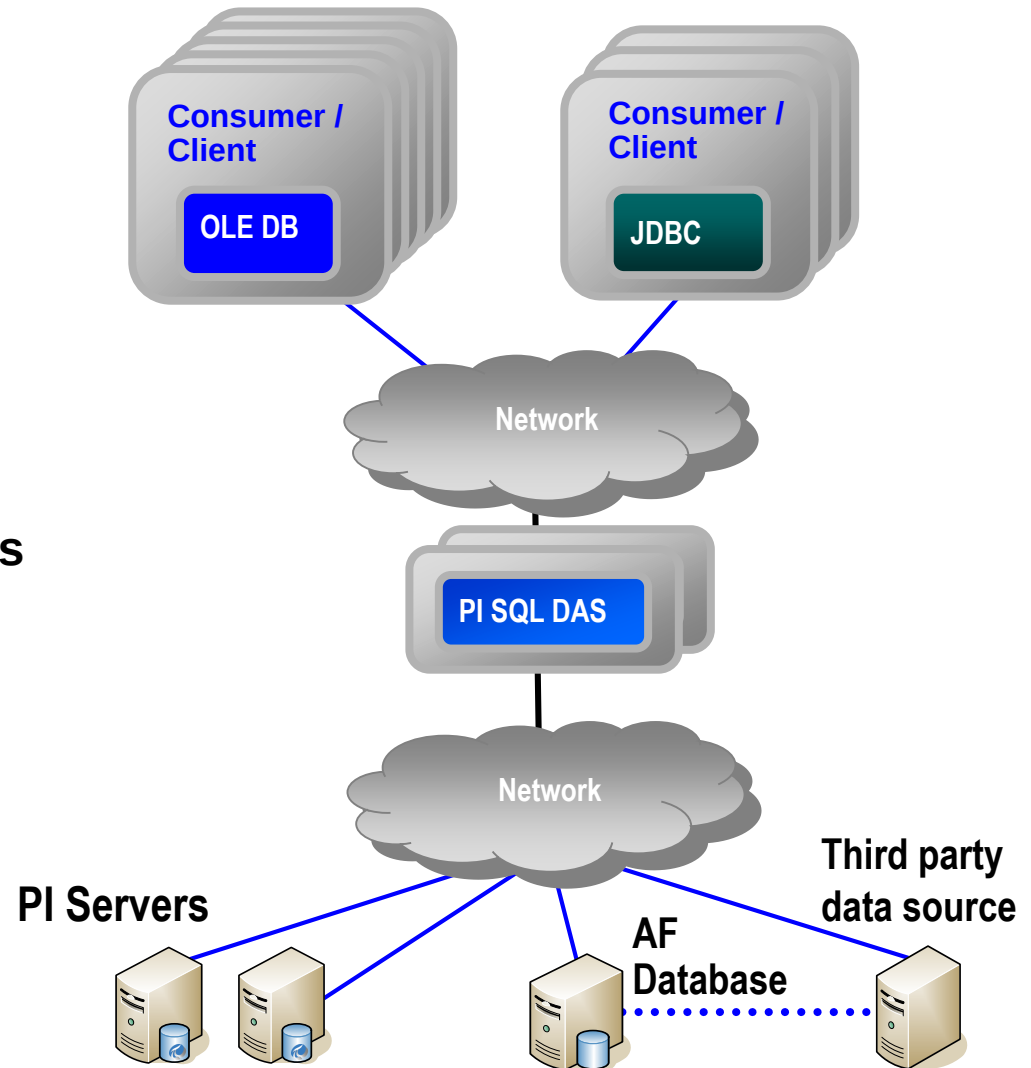
- Protects server from huge data requests
- Decreases memory requirements

- **Caching**

- Smart memory management

- **PI SQL DAS Deployment options for example:**

- 1x PI SQL DAS for Web Farm
- 1x PI SQL DAS for Reporting
- 1x PI SQL DAS for Clients



Demo

- **Linux (ubuntu7.10)**
- **DBVisualizer** allows to access and explore any jdbc Driver
- **PI JDBC (Bridge)** talking to PI OLEDB

The screenshot displays the DBVisualizer Free 6.0.7 application window. The interface includes a menu bar (File, Edit, View, Database, SQL, Bookmarks, Tools, Window, Help) and a toolbar. On the left, the 'Connections' tree shows a connection to 'PI JDBC (current version)' with a 'piarchive (Default)' schema. The main panel shows a SQL query: 'select * from piproductversion'. Below the query, a table of results is displayed:

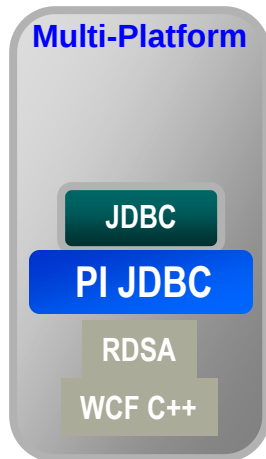
	item	descriptor	version	major	minor	build	revision
1	PI	PI Server	3.4.375.38	3	4	375	38
2	PIOLEDB	PI OLE DB Provider	3.2.2.7	3	2	2	7
3	PISDK	PI Software Development Kit	1.3.5.343	1	3	5	343

Below the table, a 'Result Set [1]' section shows a list of 26 rows of data, including timestamps and numerical values. The bottom status bar indicates 'Auto Reload Seconds: 20' and '00:00:18'.

PI JDBC Bridge

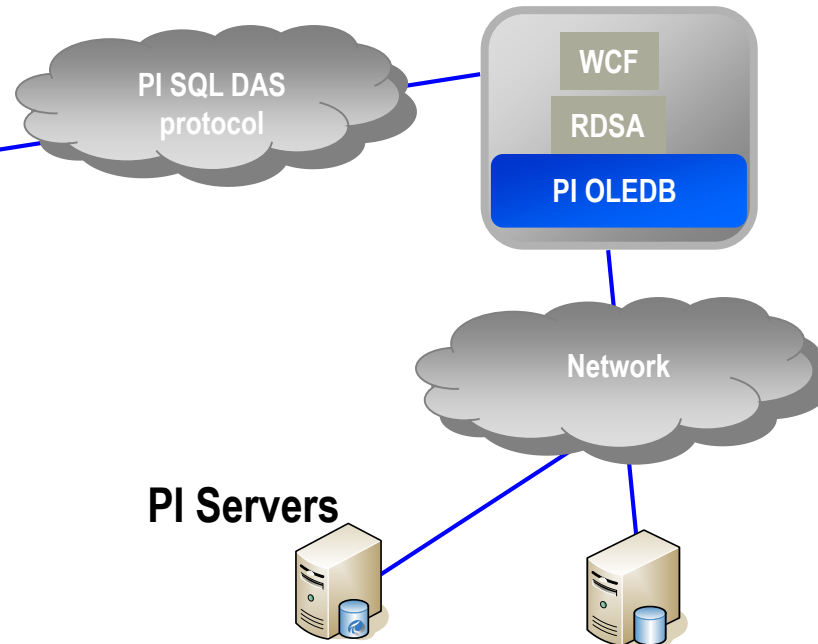
Architecture Details

Client Application



PI JDBC Bridge v1

- Windows + Linux 32bit
- requires PI OLEDB
- meant to support Java server apps



Demo

The screenshot displays the PI System OLEDB Client application. The interface includes a menu bar (File, Edit, View, Tools, Window, Help), a toolbar, and a main workspace divided into several panes.

PI System OLEDB Explorer: This pane on the left shows a hierarchical tree of the database structure. It includes Servers (BB2NOTE), Catalogs (Configuration, PISystem, Test), Asset (Tables), and Views. The 'Tables' folder under 'Asset' is expanded, showing various tables like CurElement, CurElementAttribute, Element, ElementAttribute, etc.

PI SysOleDbQueryWindow 5: This central pane contains a SQL query:

```
SELECT e.Path+e.Name Element, a.Path+a.Name Attribute, r.Time, r.Value FROM Test..ElementHierarchy e
INNER JOIN Test.Asset.ElementAttribute a
ON a.ElementVersionID = e.VersionID
INNER JOIN Test.Data.Recorded r
ON r.ElementAttributeID = a.ID
WHERE r.time BETWEEN '06-Oct-2008' AND '06-Oct-2008 12:00:00'
OPTION (FORCE ORDER)
```

Result: Below the query, a table displays the results of the query. The table has four columns: Element, Attribute, Time, and Value. The results are numbered 01 through 17.

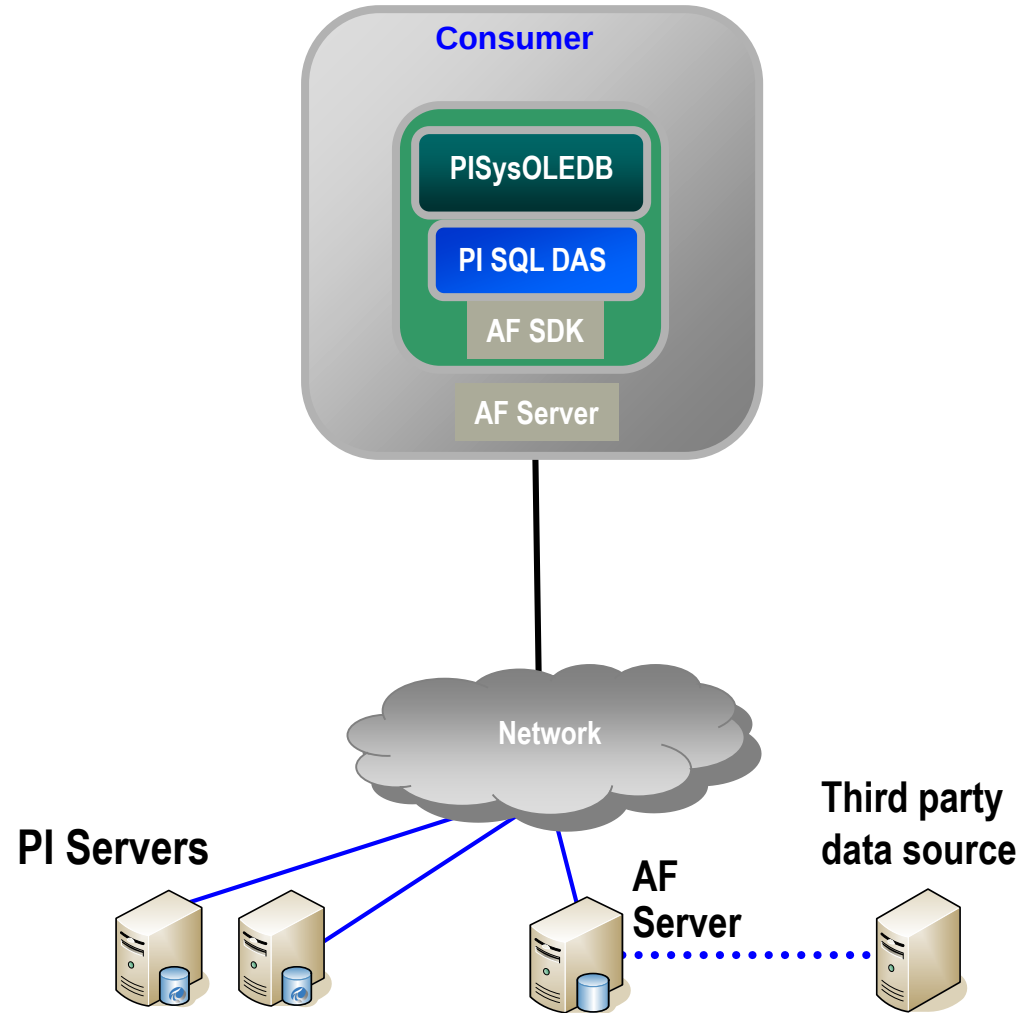
	Element	Attribute	Time	Value
01	\E_1	\A_1	10/6/2008	49.14205
02	\E_1	\A_1	10/6/2008 1:31 AM	85.66759
03	\E_1	\A_1	10/6/2008 2:40 AM	99.24164
04	\E_1	\A_1	10/6/2008 3:45 AM	96.19122
05	\E_1	\A_1	10/6/2008 4:58 AM	75.74577
06	\E_1	\A_1	10/6/2008 7:31 AM	14.17995
07	\E_1	\A_1	10/6/2008 7:42 AM	11.00134
08	\E_1	\A_1	10/6/2008 7:42 AM	System.__ComObject
09	\E_1	\A_1	10/6/2008 7:46 AM	9.941768
10	\E_1	\A_1	10/6/2008 8:51 AM	0.1380453
11	\E_1	\A_1	10/6/2008 9:57 AM	6.160055
12	\E_1	\A_1	10/6/2008 11:16 AM	31.46513
13	\E_1	\A_1	10/6/2008 12:00 PM	49.02984
14	\ET_3_1	\AT_1	10/6/2008	91.82214
15	\ET_3_1	\AT_1	10/6/2008 12:31 AM	98.46332
16	\ET_3_1	\AT_1	10/6/2008 1:31 AM	98.12081
17	\ET_3_1	\AT_1	10/6/2008 2:41 AM	81.79839

Messages: A status bar at the bottom indicates "Query executed successfully".

Bottom Bar: The bottom of the window shows the server name "BB2NOTE", the execution time "00:00:09", and the number of rows "25 rows".

PI System OLEDB v1 Architecture

- Windows based
- Linked to AF SDK
- Access via AF Server



Development Roadmap - PI SQL DAS

● PI SysOLEDB v1

- OLE DB w. integrated PI SQL DAS
- Mainly AF tables
- Read-only

» Release schedule ~ Q2/2009

● PI SQL DAS v2

- Server side PI SQL DAS
- JDBC (Linux supported)
- Event Frames

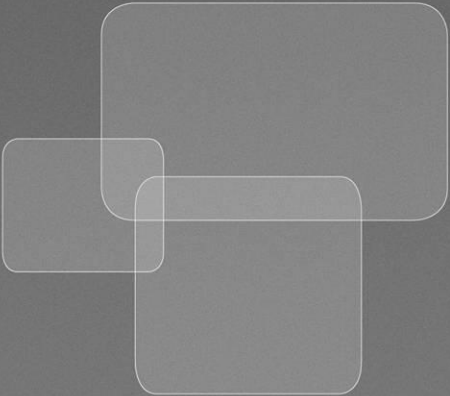
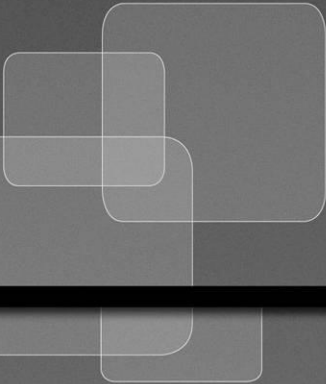
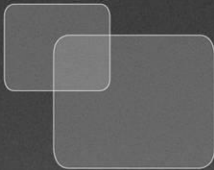
» Release ~ 2010

Examples: GoTo

- Expo - Data Access: PI OLEDB, PISysOLEDB, JDBC Bridge
- Learning Labs / Tutorials

Title	Location	Remark
PI OLEDB Basics	DEVNET, PIPC\OLEDB\Tutorials	Getting Started
Creating SSRS Reports with PI OLEDB	DEVNET, PIPC\OLEDB\Tutorials	Integration with MS SQL Server 2005 Reporting Services (SSRS)
Building a PI OLEDB/SQL Web Service	DEVNET, PIPC\OLEDB\Tutorials	Create a Web Service for executing PI OLEDB queries utilizing Visual Studio .NET 2003; Also includes Client
ADO.NET Programming via PI OLEDB	DEVNET, PIPC\OLEDB\Tutorials	Create an ADO.NET client for PI OLEDB, utilizing Visual Studio .NET 2003
Complementing RtWebParts with PI OLEDB	DEVNET, PIPC\OLEDB\Tutorials	RtWebParts accessing PI Batches and Calculations via PI OLEDB DataSets
Remote Execution of PI SQL Queries from a SQL Server 2005 Stored Procedure (CLR), (Query PI OLEDB Web Service)	DEVNET, PIPC\OLEDB\Tutorials	CLR Stored Procedure developed in Visual Studio 2005
PI OLEDB based SSIS Package for PI Annotated Data Replication	PIPC\OLEDB\Tutorials\Annotation Replication	Integration with MS SQL Server 2005 Integration Services (SSIS)
MDB-BDB Tutorial	PIPC\OLEDB\Doc PIOLEDB Manual, Appendix B	Relational Model for PI Batches and PI Module Database; How to Query PI Batches

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