

# Next Generation PI SQL

From the OSIsoft Team (Bodo Bachmann, Engineering Manager)

# A little bit of history

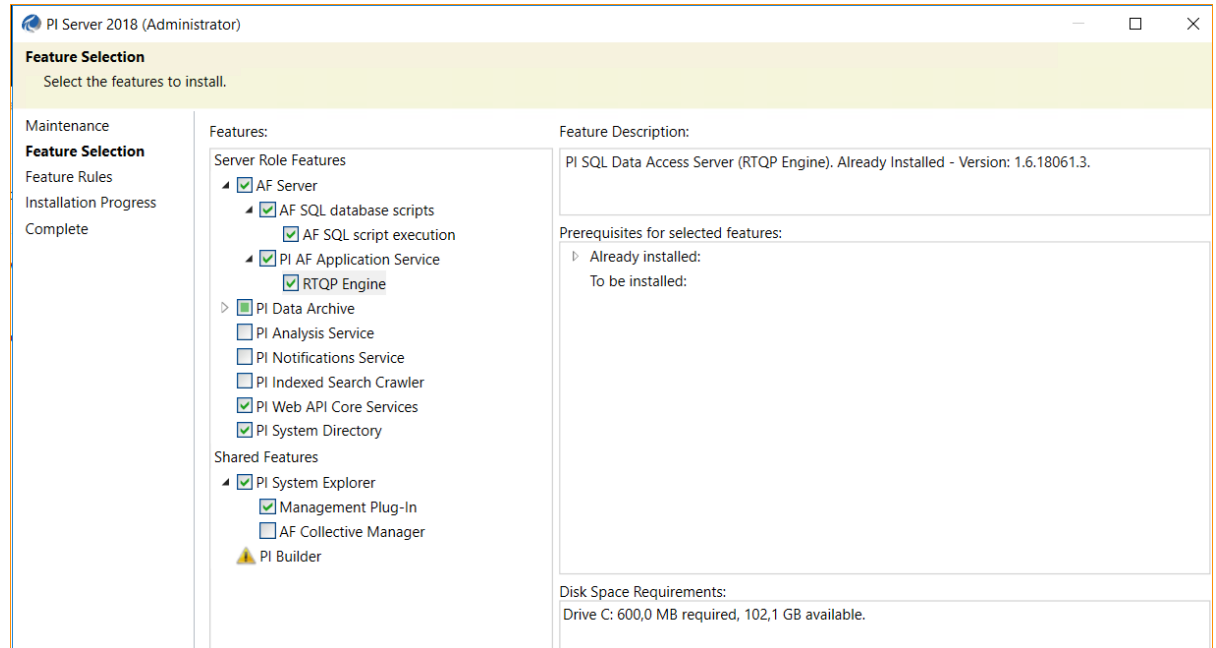
- PI OLEDB Provider
  - Read/write
  - PI SDK based (multi-threading issues, no major enhancements)
- PI OLEDB Enterprise
  - Read
  - No integration of Data Archive
  - Scalability and performance issues
  - Complex queries (compared to PI OLEDB Provider)

# Next Generation Development Goals

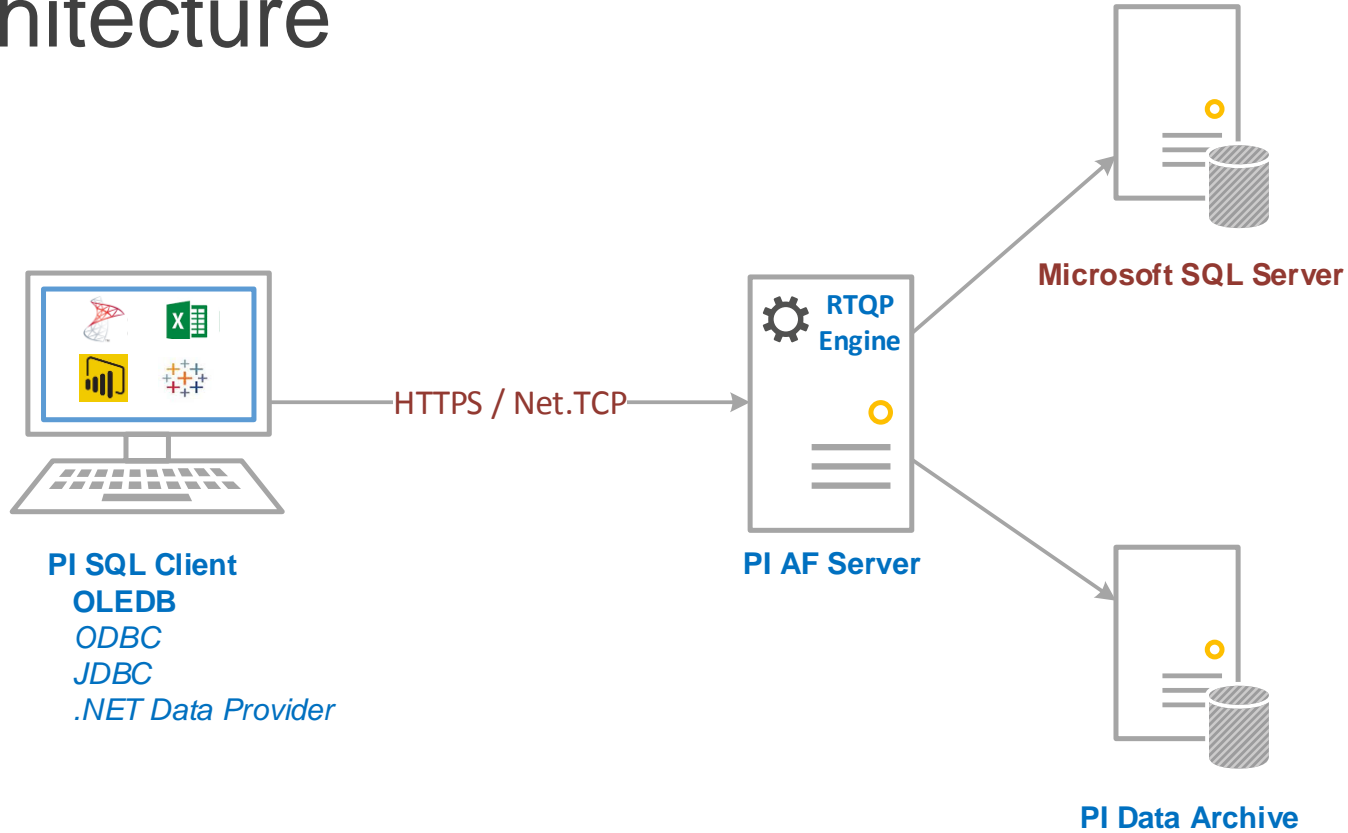
- Performance and scalability
- Review data model
  - Reduce query complexity
  - What are top use cases (use customer feedback)
  - Address known issues (e.g. timestep data type, PI time literals)
- Infrastructure to support multiple standards and thin clients
- Works across WAN and different time zones
- Review security and authentication

# Real-Time Query Processing Engine

- Part of the PI Server integrated install kit
- Optional

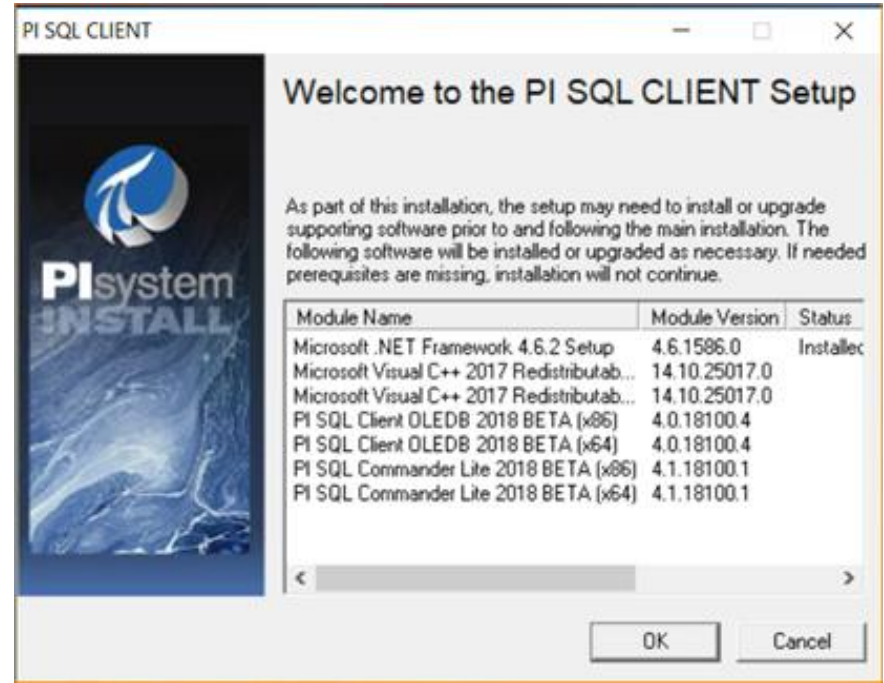


# Architecture



# Client Installation

- No AF SDK dependency
- PI SQL Commander Lite incl. Query Compendium





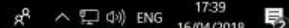
Recycle Bin



Workday



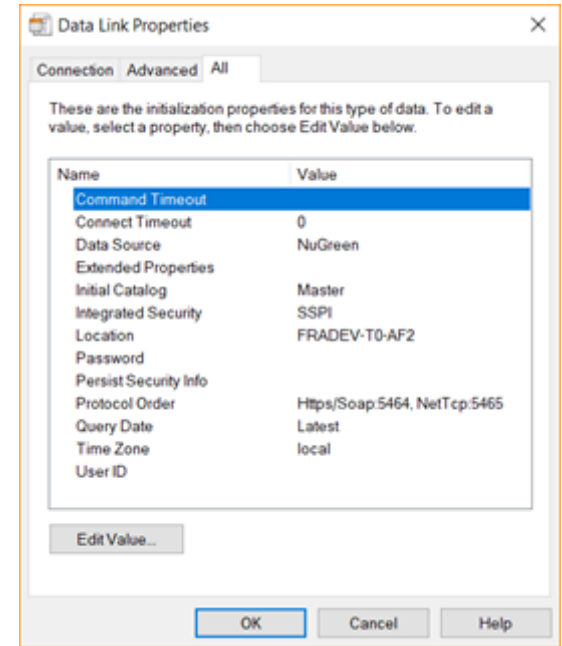
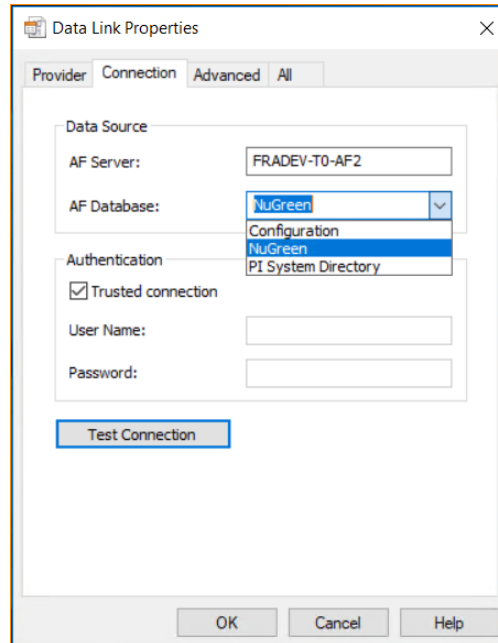
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# Connection and Connection Options

- AF Database names can be browsed when [PI Directory Service](#) and [PI Web API Core Services](#) are configured
- Time Zone support







Recycle Bin



Workday



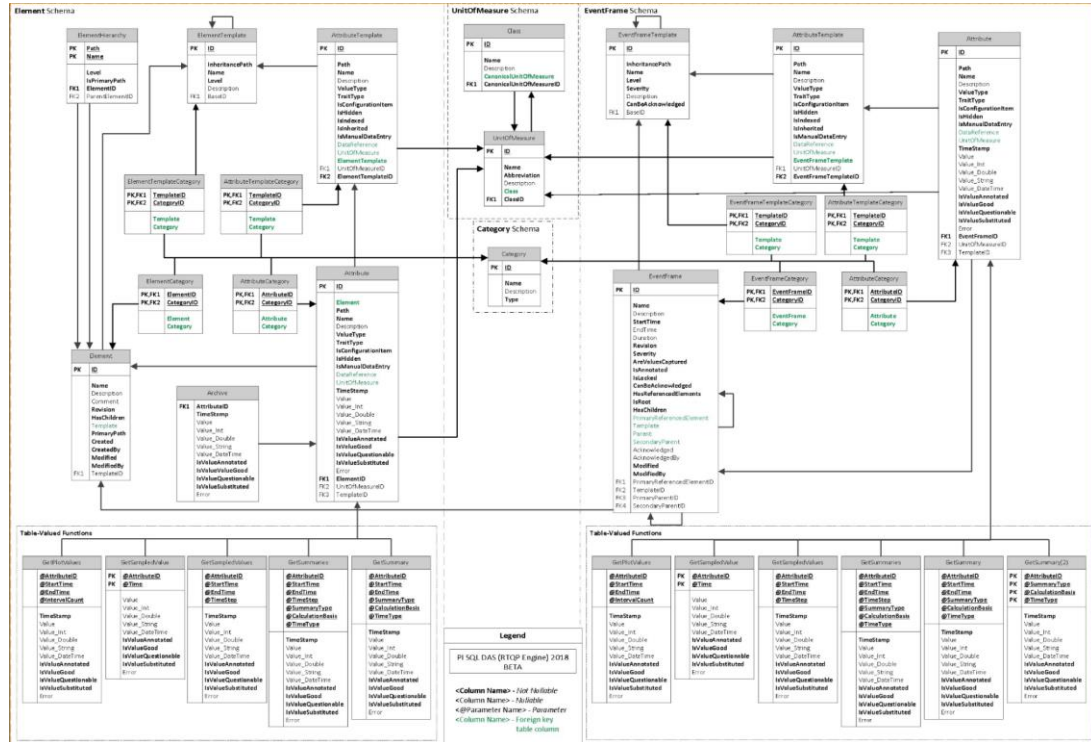
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# Catalogs and Schemas

- Connection = AF Database
- Elements and Event Frames
- Attributes and Data
- Categories and Templates
- Template based TVFs
- Multiple Value columns
- Navigation columns



# Simplified Queries

## Denormalization



Column Name	Column Type
ID	Guid, not null
Name	String(2000), not null
Description	String(2000), null
Comment	String(2000), null
Revision	Int32, not null
HasChildren	Boolean, not null
PrimaryPath	String(2000), not null
Template	String(2000), null
Created	DateTime, not null
CreatedBy	String(2000), not null
Modified	DateTime, not null
ModifiedBy	String(2000), not null
TemplateID	Guid, null

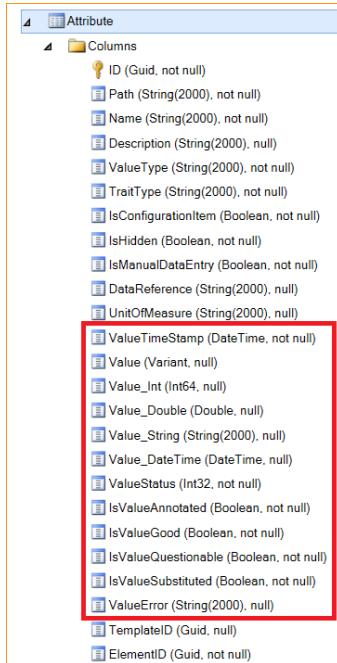
```
SELECT eh.Path + eh.Name Element, et.Name Template
FROM NuGreen.Asset.Element e
LEFT OUTER JOIN NuGreen.Asset.ElementTemplate et
    ON et.ID = e.ElementTemplateID
INNER JOIN NuGreen.Asset.ElementHierarchy eh
    ON eh.ElementID = e.ID
WHERE et.Name IN ('Boiler', 'Heater')
```



```
SELECT e.PrimaryPath + e.Name Element, e.Template
FROM Master.Element.Element e
WHERE e.Template IN ('Boiler', 'Heater')
```

# Simplified Queries

## Extension



Column Name	Data Type	Nullability
ID	Guid	not null
Path	String(2000)	not null
Name	String(2000)	not null
Description	String(2000)	null
ValueType	String(2000)	not null
TraitType	String(2000)	not null
IsConfigurationItem	Boolean	not null
IsHidden	Boolean	not null
IsManualDataEntry	Boolean	not null
DataReference	String(2000)	null
UnitOfMeasure	String(2000)	null
ValueTimeStamp	DateTime	not null
Value	Variant	null
Value_Int	Int64	null
Value_Double	Double	null
Value_String	String(2000)	null
Value_DateTime	DateTime	null
ValueStatus	Int32	not null
IsValueAnnotated	Boolean	not null
IsValueGood	Boolean	not null
IsValueQuestionable	Boolean	not null
IsValueSubstituted	Boolean	not null
ValueError	String(2000)	null
TemplateID	Guid	null
ElementID	Guid	not null

```
SELECT eh.Path + eh.Name Element, et.Name Template, ea.Name Attribute, s.Time, s.Value
FROM NuGreen.Asset.Element e
LEFT OUTER JOIN NuGreen.Asset.ElementTemplate et ON et.ID = e.ElementTemplateID
INNER JOIN NuGreen.Asset.ElementHierarchy eh ON e.ID = eh.ElementID
INNER JOIN NuGreen.Asset.ElementAttribute ea ON eh.ElementID = ea.ElementID
INNER JOIN NuGreen.Data.Snapshot s ON ea.ID = s.ElementAttributeID
WHERE et.Name IN ('Boiler', 'Heater')
AND eh.Path = N'\NuGreen\Houston\Cracking Process\Equipment\'
ORDER BY 1
```



```
SELECT e.PrimaryPath + e.Name Element, e.Template, ea.Name Attribute,
ea.ValueTimeStamp, ea.Value
FROM Master.Element.Element e
INNER JOIN Master.Element.Attribute ea ON e.ID = ea.ElementID
WHERE e.Template IN ('Boiler', 'Heater')
AND e.PrimaryPath = N'\NuGreen\Houston\Cracking Process\Equipment\'
ORDER BY 1
```

# Attribute Values and Data Types

- Only the Value column is always populated
- Unlike in PI OLEDB Enterprise, at max one native type is filled

	Name	Description	TimeStamp	ValueType	Value	Value_Int	Value_Double	Value_String	Value_DateTime	IsValueSubstituted
1	Feedrate Tag		1970-01-01 00:00:00.000	String	SINUSOID			SINUSOID		False
2	Fuel	Relative Fuel Gas Use per ton of Feed	2018-03-12 15:52:14.302	Double	1000		1000			False
3	Water Savings	Current percent savings in energy use.	2018-03-12 15:52:14.302	Double	-1920.2020202020202		-1920.2020202020202			False
4	Fuel Savings	Current percent savings in energy use.	2018-03-12 15:52:14.302	Double	48.9535477284329		48.9535477284329			False
5	WaterTarget	Water use target based on 98 % of 2007 use.	1970-01-01 00:00:00.000	Double	48.51		48.51			False
6	FuelTarget	Fuel use target based on 98 % of 2007 use.	1970-01-01 00:00:00.000	Double	1919.82		1919.82			False
7	Process Feedrate		2018-03-12 15:52:14.302	Double	94.894172668457		94.894172668457			False
8	Water(2007)	2007 Water Use	1970-01-01 00:00:00.000	Double	49.5		49.5			False
9	Fuel(2007)	2007 Fuel Gas Use	1970-01-01 00:00:00.000	Double	1959		1959			False
10	Water	Make-Up Water Use per Ton of Feed	2018-03-12 15:52:14.302	Double	1000		1000			False
11	Process	Process Name	1970-01-01 00:00:00.000	String	Cracking Plant			Cracking Plant		False
12	Plant	Plant Name	1970-01-01 00:00:00.000	String	Houston			Houston		False
13	Model	Manufacturer Model	1970-01-01 00:00:00.000	String	BX-414			BX-414		False
14	Manufacturer	Equipment Manufacturer	1970-01-01 00:00:00.000	String	Borne Engineering			Borne Engineering		False
15	Make-Up Water Tag	Make-Up Water PI Tag	1970-01-01 00:00:00.000	String	SINUSOID			SINUSOID		False
16	Water Flow	Make-Up Water Flow	2018-03-12 15:52:14.302	Double	94.894172668457		94.894172668457			False
17	Installation Date	Installation Date	1970-01-01 00:00:00.000	DateTime	5/16/1985 6:00:00 AM				1985-05-16 06:00:00.000	False
18	Fuel Gas Flow Tag	Fuel Gas Flow PI Tag	1970-01-01 00:00:00.000	String	SINUSOID			SINUSOID		False
19	Fuel Gas Flow	Fuel Gas Flow Rate	2018-03-12 15:52:14.302	Double	94.894172668457		94.894172668457			False
20	Burner	Burner Model	1970-01-01 00:00:00.000	String	TZ-14			TZ-14		False
21	Asset Name	Asset Process Name	1970-01-01 00:00:00.000	String	High Pressure			High Pressure		False

# Sample Queries and Performance

The screenshot displays the PI SQL Commander Lite interface. On the left is the Object Explorer showing a tree of OLEDB Data Sources under PI OLEDB Enterprise, including various AF1, AF2, and AF210 servers. The main window shows two queries and their results.

**Query 2: Query2.sql - FRADEV-T2-AF210\***

```
SELECT top 3000 e.Name, sSP.ValueStr "Service Point", sY.ValueDb1 "Y", sX.ValueDb1 "X"
FROM Element e
INNER JOIN ElementAttribute eaSP ON eaSP.ElementID = e.ID
INNER JOIN ElementAttribute eaX ON eaX.ElementID = e.ID
INNER JOIN ElementAttribute eaY ON eaY.ElementID = e.ID
INNER JOIN Data.Snapshot sSP ON sSP.ElementAttributeID = eaSP.ID
INNER JOIN Data.Snapshot sX ON sX.ElementAttributeID = eaX.ID
INNER JOIN Data.Snapshot sY ON sY.ElementAttributeID = eaY.ID
INNER JOIN ElementTemplate et ON et.ID = e.ElementTemplateID
WHERE eaSP.Name = 'ServicePointID'
AND eaX.Name = 'X'
AND eaY.Name = 'Y'
AND sX.ValueDb1 BETWEEN 2210000. AND 2220000.
AND sY.ValueDb1 > 390000. AND sY.ValueDb1 < 400000.
AND et.Name = 'SilverSpringMeter'
ORDER BY Y DESC, Name -- North to South
```

**Results for Query 2:**

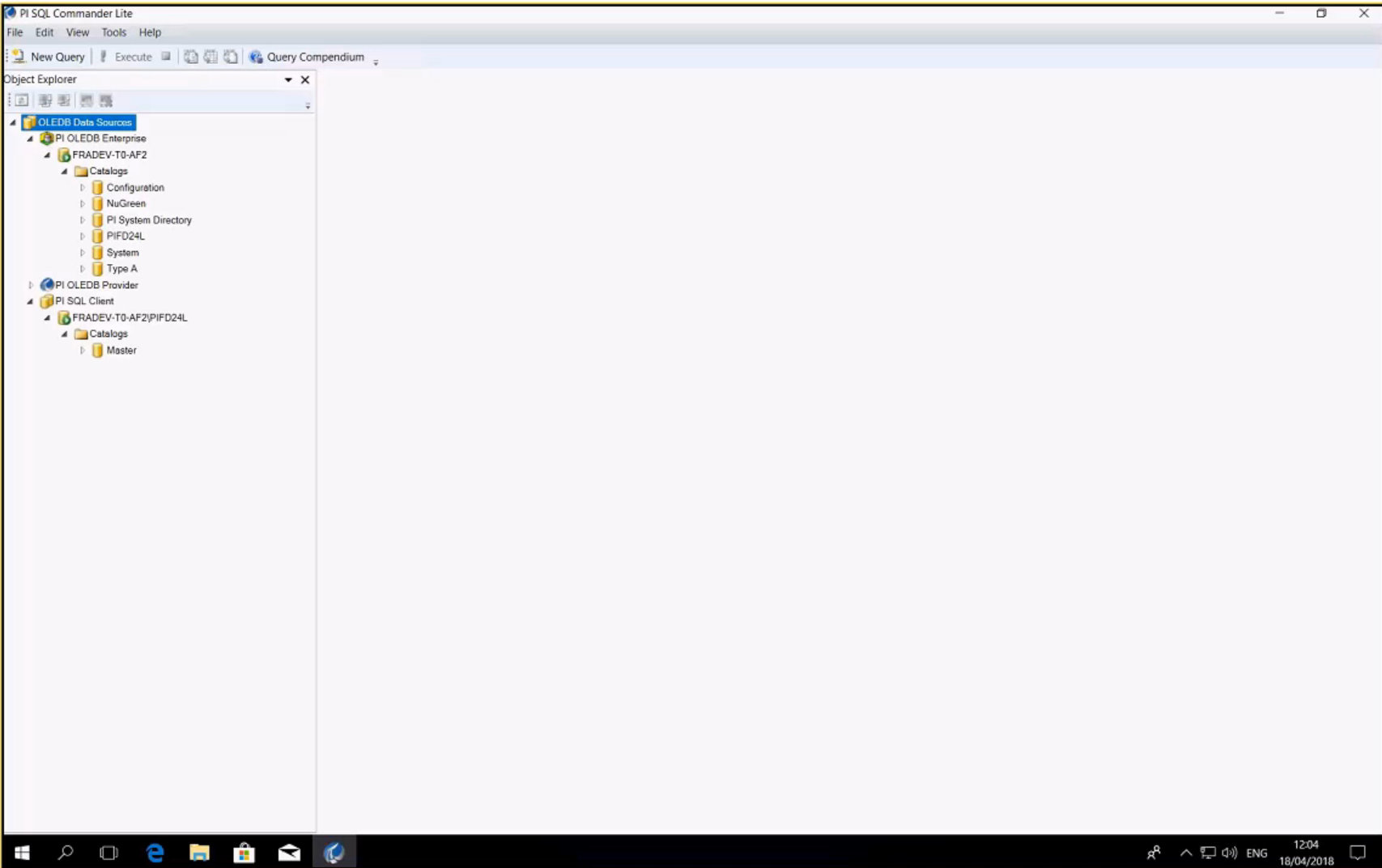
Name	Service Point	Y	X
1 SilverSpring_NP_ab00dd10027f	SPE_ab00dd10027f	399999.364297941	2213255.1212611
2 SilverSpring_NP_ab00dd100040	SPE_ab00dd100040	399998.395467848	2213695.82871303
3 SilverSpring_NP_ab00dd1002b4	SPE_ab00dd1002b4	399995.923031852	2215560.89486477

**Query 3: Query3.sql - FRADEV-T2-AF210(PIFD24L\***

```
SELECT top 3000 e.Name, eaSP.Value_String "Service Point", eaY.Value_Double "Y", eaX.Value_Double "X"
FROM Element e
INNER JOIN ElementAttribute eaSP ON eaSP.ElementID = e.ID
INNER JOIN ElementAttribute eaX ON eaX.ElementID = e.ID
INNER JOIN ElementAttribute eaY ON eaY.ElementID = e.ID
WHERE eaSP.Name = 'ServicePointID'
AND eaX.Name = 'X'
AND eaY.Name = 'Y'
AND eaX.Value_Double BETWEEN 2210000. AND 2220000.
AND eaY.Value_Double > 390000. AND eaY.Value_Double < 400000.
AND e.Template = 'SilverSpringMeter'
ORDER BY Y DESC, Name -- North to South
```

**Results for Query 3:**

Name	Service Point	Y	X
1 SilverSpring_NP_ab00dd10027f	SPE_ab00dd10027f	399999.364297941	2213255.1212611
2 SilverSpring_NP_ab00dd100040	SPE_ab00dd100040	399998.395467848	2213695.82871303
3 SilverSpring_NP_ab00dd1002b4	SPE_ab00dd1002b4	399995.923031852	2215560.89486477
4 SilverSpring_NP_ab00dd10013e	SPE_ab00dd10013e	399992.44567661	2215416.38399895
5 SilverSpring_NP_ab00dd1002e9	SPE_ab00dd1002e9	399992.336096764	2215277.20087835



# Roadmap

- Q2/2018:
  - PI SQL Client with OLEDB
  - PI SQL Data Access Server (RTQP Engine)
- Q4/2018:
  - PI SQL Client adding ODBC and JDBC support
- Later:
  - Direct Tag based queries
  - INSERT/UPDATE/DELETE for Event Frames and Attribute/Tag data



# Questions

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# PI SQL Family



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- Engineering Manager Europe
- OSIssoft

Merci

谢谢

Спасибо

Danke

Gracias

Thank You

감사합니다

ありがとう

Grazie

Obrigado

Optional: Click to add a takeaway you wish the audience to leave with.