FME® for Data Analytics Workflows

Training Manual 2013-SP3 Edition

SAFE SOFTWARE

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Revisions

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Document Information

Document Name:	FME for Data Analytics Workflows
FME Version:	FME Desktop 2013-SP3 Build 13528 32-bit
Operating System:	Windows 7 SP-1, 64-bit
Updated:	August 2013

Welcome to Safe Software

Course Overview

Course Overview

- Who am I?
- Certified FME Trainers
- Course Goal
- Course Structure

This is an introductory-level, general training course for users of FME working on Data Analytics workflows

Who Am I?
This is the instructor's chance to introduce herself or himself.

Certified FME Trainers
Your FME training instructor may possess FME certified trainer status, indicating Safe Software's guarantee of quality for your FME training course.

If you have comments or concerns about your training then please contact us via our website (*www.safe.com/contact*), or else through our Training Manager directly at *train@safe.com*

Course Goal
This training course provides a framework for understanding FME, upon which a user can base their work. We find users come to master one function, but go home with many new FME uses!

The training will introduce basic concepts and terminology, help students become efficient users of FME, and direct you to resources to help apply the product to your own needs.

Course Structure
The course is made up of three main sections. These sections are:

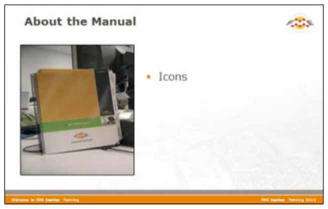
- Data Translation Basics
- Data Transformation
- Translation Components

The instructor may choose to cover as many of these sections as they feel are required, or possible in the time permitted. They may also cover the course content in a different order and will skip or add new content to better customize the course to your needs

FME Version
This training material is designed specifically for use with FME2013-SP3. You may not have some of the functionality described if you use an older version of FME.

Sample Data
The sample data required to carry out the examples and exercises in this document can be obtained from: **www.safe.com/fmedata**

About the Manual


About the Manual

- Icons

Welcome to FME Desktop Training

FME Desktop Training 2013

The FME Desktop training manual and exercise workbook are yours to keep. They include detailed material to help you remember your training.

This manual forms the basis for FME Desktop training – in-person or online – but is also useful reference material for future work you may undertake with FME.

Icons
In the training manual you may see the following icons…

Tip: Additional advice to help apply the knowledge you have learned.

Caution: A warning where misuse of FME could lead to difficulties.

Example or Exercise: An example or exercise that the instructor will use to demonstrate a particular point or feature of FME. You may work through the example with the instructor or on your own.

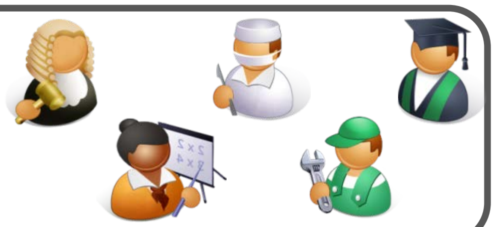
Advanced Exercise: Extra challenges for students who are quick to finish and want to take an exercise a little bit further.

New: A feature new to, or significantly changed in, the most recent version of FME.

Q&A: Questions about the course content and how it is applied.

Important hints and tips appear in a box like this, to separate them from ordinary content.

Also, people from the city of Interopolis will also appear from time-to-time to give you advice and dispense FME-related wisdom.



Course Resources

Course Resources

- On your Training Computer
- On your Virtual Machine
- Course Etiquette

Welcome to FME Desktop Training FME Desktop Training 2013

A number of sample datasets and workspaces will be used in this course.

On Your Training Computer

The data used in this training course is based on datasets from the fictional City of Interopolis.

Most exercises ask you to assume the role of a city planner and solve a particular problem using both the City's corporate data and data provided by external agencies.

Resources for the examples and exercises in the manual can be found at the following locations:

Location	*Resource*
C:\FMEData\Data	Datasets belonging to the City of Interopolis and local organizations and companies
C:\FMEData\Resources	Resources used in the training such as datasets that don't fit into the City of Interopolis
C:\FMEData\Workspaces	Workspaces used in the student exercises. There are subfolders for each session
C:\FMEData\Output	The location in which to write exercise output. There are subfolders for each session
< documents>\My FME Workspaces	The default location to save FME workspaces

On Your Virtual Machine

If you are taking FME Desktop training online, you may be provided with a virtual machine hosted in the cloud. If so, you should find all of the above resources, plus a copy of the FME release used in the training, just as if you were working on a physical computer.

You should also find a digital copy of this manual, either on the computer desktop or in the documents folder.

Please alert your instructor if any item is missing from your setup.

Course Etiquette

For online courses, please consider other students and test your virtual machine connection *before* the course starts. The instructor cannot help debug connection problems during the course!

For live courses, please respect other students' needs by keeping noise to a minimum when using a mobile phone or checking e-mail.

About Safe Software

About Safe Software

- History of Safe Software
- The Safe Software Vision
- The Safe Software Mission

Achieve total spatial data mastery!

Safe Software: Achieve total spatial data mastery!

History of Safe Software
Safe Software Inc. is the maker of FME® and the global leader in spatial data transformation technology that helps GIS professionals and organizations master their data interoperability challenges.

A common question is, “where did the names ‘Safe Software’ and ‘FME’ come from?”

Safe Software was founded way back in 1993 by Don Murray and Dale Lutz.

Back then, there was a format called the Spatial Archive and Interchange Format (SAIF). Since “SAIF” is pronounced “safe,” we decided to take the name Safe Software as a play on the SAIF format name.

FME officially stands for the Feature Manipulation Engine, and reflects its ability to transform data. By 2008, we had shortened it to “FME,” since by then most everyone knew what we were talking about, and to be honest, it was a mouthful.

Another common question is, “what happened to your hair?”, but that’s a story for another time!

Today, FME is used by thousands of customers in over 116 countries in a wide variety of industries. Our channel partner network has more than 100 value-added resellers across six continents.

The Safe Software Vision…

‘Our vision is to be the global leader in spatial data transformation, to knock down every last barrier to free and unrestricted spatial data use.’

The Safe Software Mission Statement…

‘Our mission is to help organizations use spatial data more easily and efficiently.’

Introductions

FME Training Presentation
Welcome to FME Desktop Training
FME® Desktop 2013 version

Safe Software's standalone, web-based, and embedded software products are used by a worldwide network of clients from a wide range of organizations and industries.

Who are you?

What formats interest you?

What do you hope to achieve during this course?

Have you used FME before?

This is your chance to introduce yourself to the rest of the class. You may want to mention the organization you represent, what experience you have using FME, and which formats and functionality you're most interested in.

Please think of the environment and don't print this manual unless you really need to. Using a digital copy or sharing with a colleague will help save paper. And don't forget to recycle printed copies when you are finished with them!

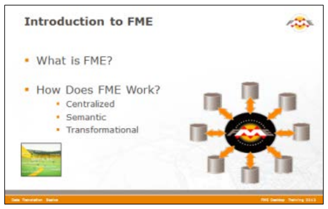
You can find an online version of this manual by browsing the Safe Software training catalog at:

http://www.safe.com/learning/training/course-schedule/course-catalog/

…and clicking on the links marked "Resource Centre".

Data Translation Basics

Introduction to FME


Introduction to FME

- What is FME?
- How Does FME Work?
  - Centralized
  - Semantic
  - Transformational

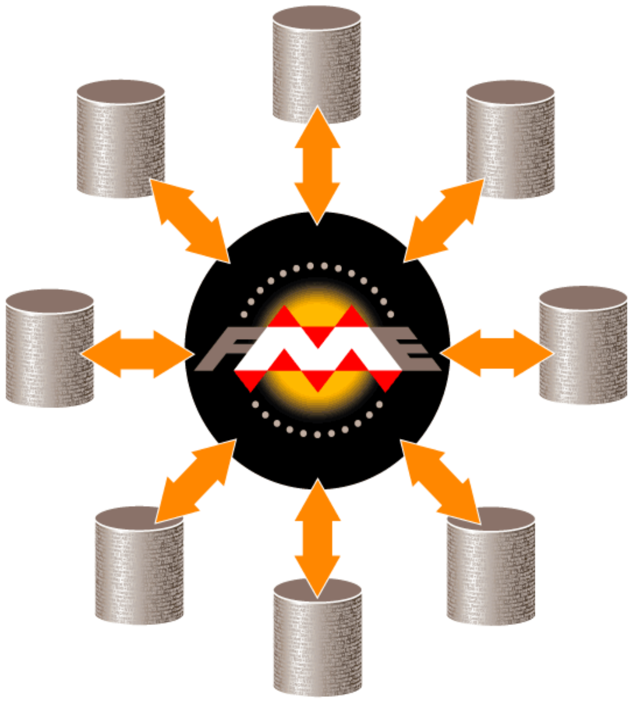
FME is specifically designed for Data Transformation. Its key characteristics illustrate why it is so suitable for this role.

What is FME?
FME (Feature Manipulation Engine) was designed as a Data Transformation tool to break down barriers to spatial data interoperability. In fact, it is often classed as a **Spatial ETL** application.

ETL stands for *Extract, Transform and Load*. It is a data warehousing tool that extracts data from a source, transforms it to fit the users' needs and loads it into a destination or data warehouse.

A Spatial ETL tool is the geographic equivalent of ETL.

While an ETL tool will process the various column types that are in a non-spatial database or system, a Spatial ETL tool must also have the spatial operations - geoprocessing capabilities that change the structure and representation of spatial data – needed to move data from one spatial database or GIS to another.



How Does FME Work?
FME has a number of key characteristics:

Centralized
FME is a central engine among an array of supported format. Data can be read from any format and written to any other.

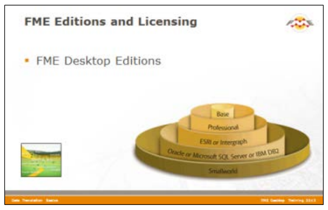
Adding support for a new format is as simple as plugging it into the FME engine.

FME can support both raster and vector formats (among many others) under the same centralized model.

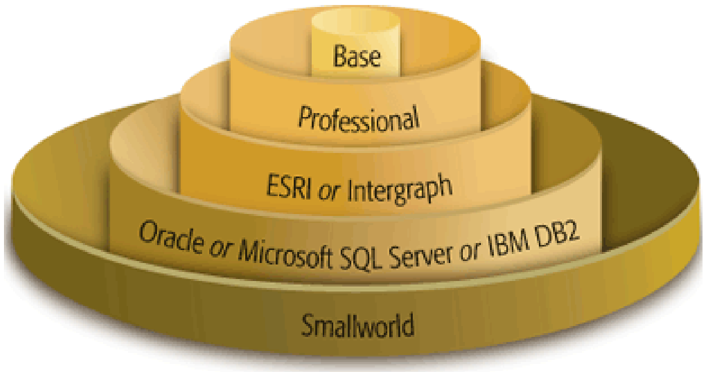
Semantic
FME has a rich data model designed to cover all possible geometry and attribute types. When limitations in the destination (output) format cause incompatibility, FME automatically compensates to create a seamless translation process.

Transformational
The 'T' in ETL is what plain format-translation tools lack. FME provides tremendous transformation functionality, resulting in output that can be much greater than the sum of the inputs, and allowing data to be transformed from one type (for example, GIS) to another (for example, CAD).

FME Editions and Licensing



FME comes in a range of different editions that vary according to the needs of the user.



FME Desktop Editions
FME is available in a number of editions.

Each edition has a different set of functions and formats available, but includes all the features from lesser editions.

FME Base edition
This is an entry-level FME edition that supports 40 formats and a set of basic transformation tools.

FME Professional edition
This is a general purpose FME edition with more formats and the full set of transformation tools.

Esri/Intergraph editions
These editions add support for formats tied to a specific application; for example the Esri edition includes support for Geodatabase and the Intergraph edition support for writing GeoMedia.

Oracle/SQL Server/DB2 editions
These editions add support for mostly database formats; for example the Oracle edition includes support for writing to Oracle Spatial databases.

Smallworld
This edition adds support for GE Smallworld reading and writing.

Always check **www.safe.com** for the latest info on which editions support which formats.

FME Licensing
A common mistake is to think each edition is a different download/installer file. This is not true. All editions of FME Desktop have the same installer, with different functionality being unlocked by different licenses.

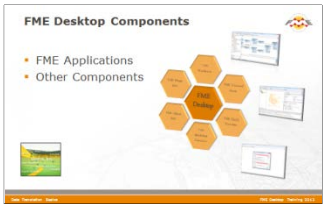
FME has two licensing methods:

Node-Locked (Fixed) License
A node-locked license is for use with FME on a specific computer only. The license cannot be transferred to another computer except by a special request to Safe Software.

Floating (Concurrent) License
Floating licenses are held on a server and issued to individual users as they start up FME. This is useful for the situation where there are many FME users, but not all using FME at the same time.

Operating Systems
FME is available on both 32 and 64-bit platforms. See the web site for more information on 64-bit.

FME Desktop Components

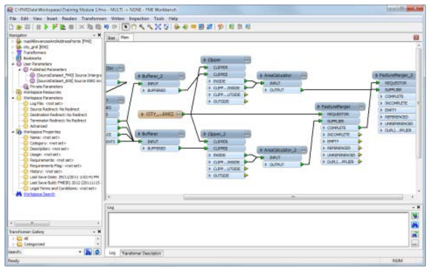

FME Desktop Components

- FME Applications
- Other Components

FME comprises a number of spatial data handling components. Everything here is included with every edition of FME Desktop.

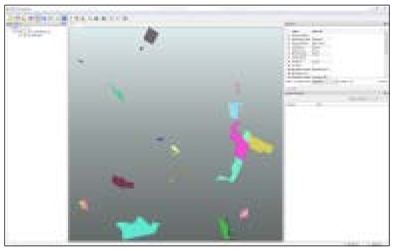
FME Applications

There are three key applications within the FME Desktop suite; FME Workbench, FME Data Inspector, and FME Quick Translator.



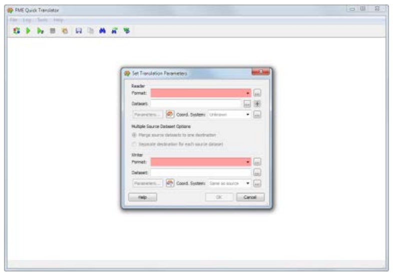
FME Workbench

FME Workbench has an intuitive point-and-click graphic interface to enable translations to be graphically described as a flow of data. FME Workbench is the primary tool for data translations in FME.



FME Data Inspector

The FME Data Inspector utility allows quick viewing of data in any of the FME supported formats. It is used primarily for data validation and quality assurance by allowing the previewing of data before translation or its reviewing after translation.



FME Quick Translator

The FME Quick Translator is used for quick format translations, or for running more sophisticated translations created in FME Workbench.

Other FME Components

Additional components are also included as part of FME Desktop (Professional Edition or higher).

FME Command Line Engine

The FME Command Line Engine enables translations to be initiated at the command line level.

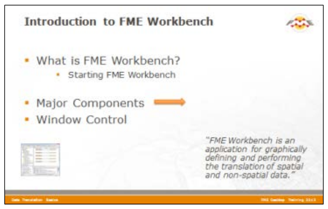
FME Application Extenders

FME Application Extenders are FME components embedded into other GIS applications. These commonly enable a GIS product to view datasets not native to that application.

FME Plug-In SDK

The FME Plug-In SDK allows developers to add formats and functionality to the FME core.

Introduction to FME Workbench


Introduction to FME Workbench

- What is FME Workbench?
  - Starting FME Workbench
- Major Components
- Window Control

"FME Workbench is an application for graphically defining and performing the translation of spatial and non-spatial data."

Workbench is FME's primary tool for data translations. Its intuitive point-and-click graphic interface allows translations to be graphically described as a flow of data.

What is FME Workbench?

FME Workbench is an application for defining data translation and transformation processes.

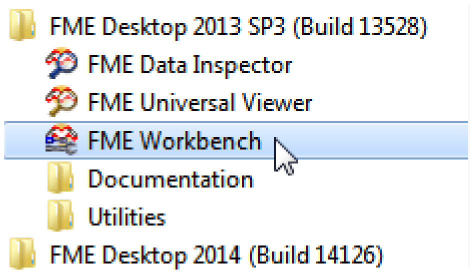
With Workbench, underlying FME functionality is exposed in an intuitive interface that allows users to graphically define a custom dataflow from source, through transformation, to destination.

Workbench has tools for defining the source and destination dataset structure (or schema), and also for manipulating the geometry and attributes of spatial data.

Workbench is fully integrated to interact with other FME applications such as the FME Data Inspector and other products such as FME Server, and is the authoring tool for FME Server models.

Starting FME Workbench

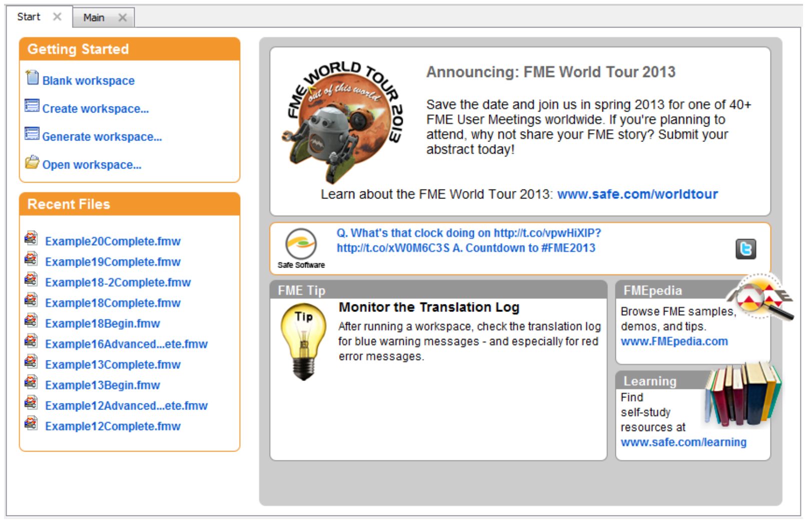
Find FME Workbench in the FME Desktop sub-menu in the Windows start menu. Click on the sub-menu entry to start Workbench.


FME Desktop 2013 SP3 (Build 13528)
- FME Data Inspector
- FME Universal Viewer
- FME Workbench
- Documentation
- Utilities

FME Desktop 2014 (Build 14126)

Workbench is located under the FME Desktop entry in the Windows start menu.

When FME Workbench starts, it opens with a startup screen shown as a tabbed window. This window has shortcuts to tools for defining a translation, and also shows information to help get users started with FME.


Start | Main

Getting Started
- Blank workspace
- Create workspace...
- Generate workspace...
- Open workspace...

Recent Files
- Example20Complete.fmw
- Example19Complete.fmw
- Example18-2Complete.fmw
- Example18Complete.fmw
- Example18Begin.fmw
- Example16Advanced...ete.fmw
- Example13Complete.fmw
- Example13Begin.fmw
- Example12Advanced...ete.fmw
- Example12Complete.fmw

Announcing: FME World Tour 2013

Save the date and join us in spring 2013 for one of 40+ FME User Meetings worldwide. If you're planning to attend, why not share your FME story? Submit your abstract today!

Learn about the FME World Tour 2013: www.safe.com/worldtour

Q. What's that clock doing on http://t.co/vpwHiXIP? http://t.co/xW0M6C3S A. Countdown to #FME2013

FME Tip

Monitor the Translation Log

After running a workspace, check the translation log for blue warning messages - and especially for red error messages.

FMEpedia

Browse FME samples, demos, and tips. www.FMEpedia.com

Learning

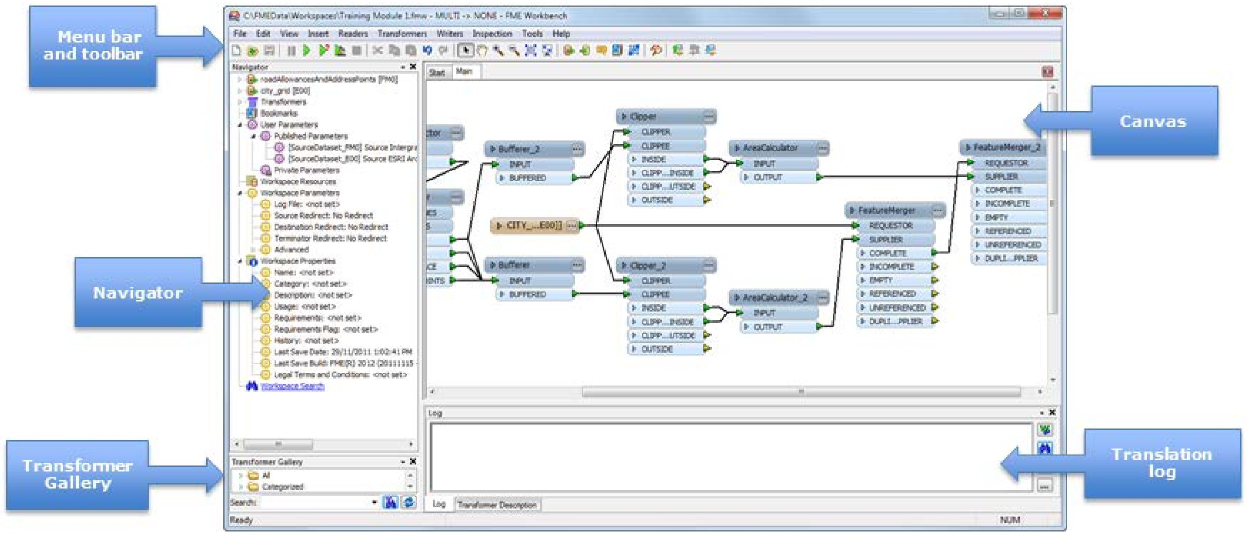
Find self-study resources at www.safe.com/learning

The startup tab links to a live web page and therefore the display will change over time as new information and resources are shown.

A second tab – Main – displays a canvas where the actual translation will be graphically defined.

Major Components of FME Workbench

The FME Workbench user interface has a number of major components.



Menu bar and Toolbar

The menu bar and toolbar contain a number of tools: for example, tools for navigating around the workspace, controlling administrative tasks, and adding or removing Reader (source) datasets.

Canvas

The FME Workbench canvas is where users graphically define a translation. This definition is called a “workspace” and can be saved for re-use later.

By default the workspace reads from left to right; data source on the left, transformation tools in the center, and data destination on the right. Connections between each item represent the flow of data and may branch in different directions or even lead to a dead-end if required.

Terminology: *To be precise the application itself is called Workbench, but the process defined in the canvas window is called a “Workspace”. The terms are so similar that they are easily confused. The difference is minor so it doesn’t really matter, but listen to certain instructors grind their teeth when you get it wrong!*

Navigator

The navigator is an explorer type tool that is used to define source and destination datasets, plus all other parameters that apply to reading and writing these datasets.

Transformer Gallery

The transformer gallery is a tool for the location and selection of FME transformation tools.

Translation Log

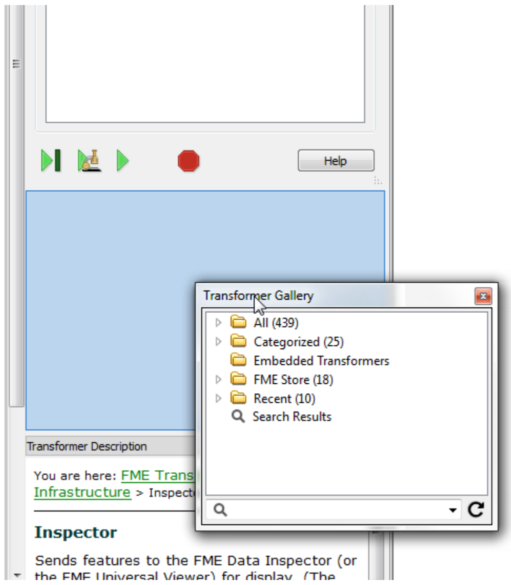
The log window (translation log) shows a report on translation results. Information includes any warning or error messages, translation status, length of translation, and number of features processed.

Overview Window (Not shown above)

The overview window shows a small-scale view of the current FME workspace, and is therefore most useful when a large workspace is being worked upon.

Window Control

All windows in the Workbench interface can be detached from a fixed position and deposited in a custom location by clicking on the frame of the window and dragging it into a new position. The windows can even float outside of the main Workbench window.



You are here: FME Trans
Infrastructure > Inspect

Inspector

Sends features to the FME Data Inspector (or the FME Universal Viewer) for display. (The

Stacking windows (such as the Navigator and Transformer Gallery) means one appears either vertically above the other (on the left or right hand side of Workbench) or horizontally next to each other (at the top or bottom of Workbench).

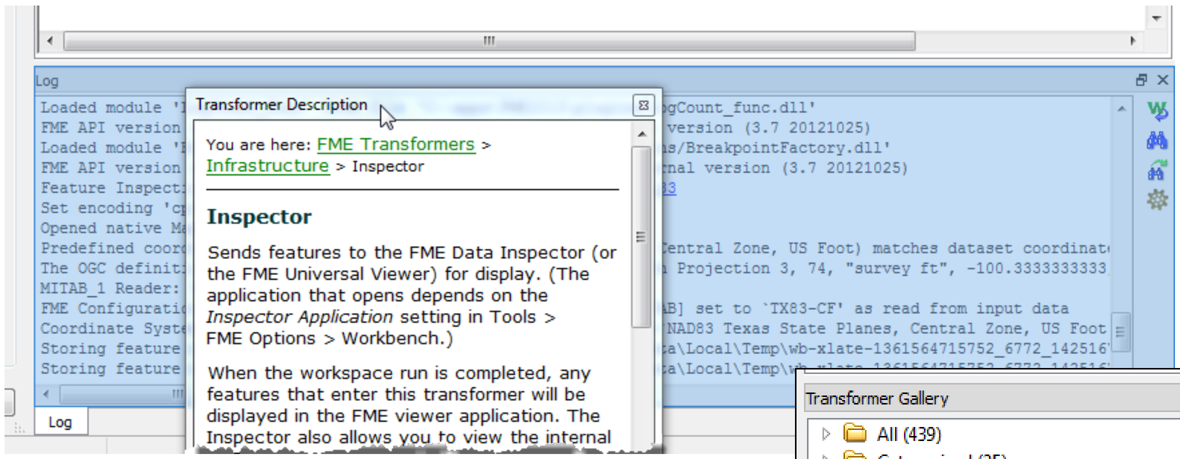
The functionality to stack or tab windows is controlled by the way the window is dragged and dropped into a new position.

If a window is dragged and dropped on top of an existing window, then the two will become tabbed.

If a window is dragged and dropped beside an existing window (or between two existing windows), then they will become stacked.

Here a user is stacking the Transformer Gallery between two other windows on the left-hand side of Workbench.

Here a user is choosing to arrange the Transformer Gallery and Log Window in a tabbed configuration.



```
Loaded module '
FME API version
Loaded module '
FME API version
Feature Inspect
Set encoding 'c
Opened native M
Predefined coor
The OGC definit
MITAB_1 Reader:
FME Configurati
Coordinate Syst
Storing feature
Storing feature
```

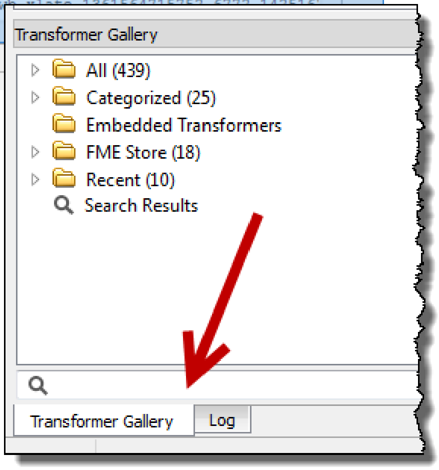
```
gCount_func.dll'
version (3.7 20121025)
s/BreakpointFactory.dll'
nal version (3.7 20121025)
3

entral Zone, US Foot) matches dataset coordinat
 Projection 3, 74, "survey ft", -100.3333333333

B] set to `TX83-CF' as read from input data
NAD83 Texas State Planes, Central Zone, US Foot
a\Local\Temp\wb-xlate-1361564715752_6772_142516
a\Local\Temp\
```

You are here: FME Transformers > Infrastructure > Inspector

Inspector

Sends features to the FME Data Inspector (or the FME Universal Viewer) for display. (The application that opens depends on the *Inspector Application* setting in Tools > FME Options > Workbench.)

When the workspace run is completed, any features that enter this transformer will be displayed in the FME viewer application. The Inspector also allows you to view the internal



The result will look like this:

Functionality: *The F11 button toggles the Workbench canvas between full screen mode and back again. Shift+F11 does the same thing, but leaves the menubar and toolbar available for use. Try it and see for yourself!*

Miss Vector says…

'Attention please! It's time for a quiz to see what you've learned so far. Turn to a fellow student and answer these questions between you.'

Which of the following words describe FME Desktop?

1) Distributed ☐
2) Semantic ☐
3) Transformational ☐
4) Centralized ☐

Which of the following applications are parts of FME Desktop?

1) FME Workbench ☐
2) FME Server ☐
3) FME Quick Translator ☐
4) FME Data Inspector ☐

Which of the following tools is not found in FME Workbench?

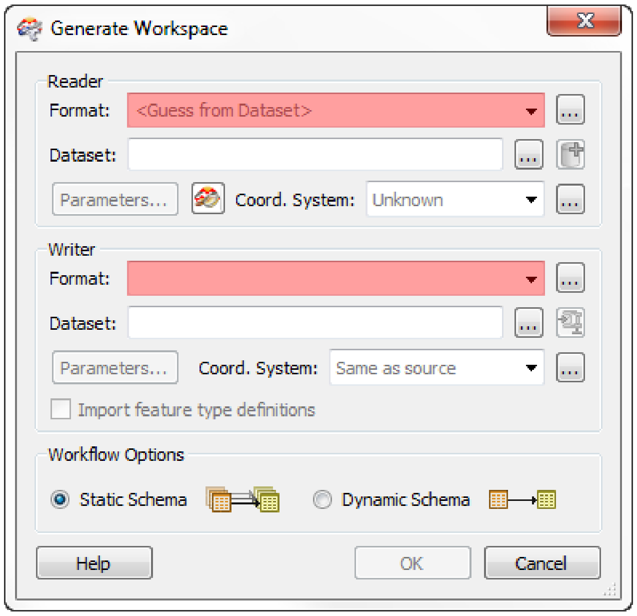
1) A data inspection tool ☐
2) A source data selection tool ☐
3) A destination data selection tool ☐
4) Data manipulation tools ☐

Which of the following windows are on the Workbench interface?

1) Navigator ☐
2) Transformer Gallery ☐
3) Log Window ☐
4) Display Control Window ☐

Generating a Translation

The Generate Workspace dialog condenses all the initial translation choices into a single dialog box. This is the preferred workspace creation tool. It can be accessed through the Getting Started menu in the Workbench start tab, or by using the shortcut key Ctrl+G.



The Generate Workspace dialog has fields for the Reader and Writer Formats and Datasets. These prompts have a drop-down menu and 'Intelli-complete' properties to assist in selecting a format.

The red fields indicate mandatory fields. Users must enter data in these fields to continue. Notice that the OK button is de-activated until the mandatory fields are complete.

There are also buttons for checking and/or altering parameters for each dataset, and a button for previewing the data in the FME Data Inspector.

Terminology: *In most cases FME uses the terms 'Reader' and 'Writer' instead of 'Source' and 'Destination'. Session 3 explains the why. For now, just note that a Reader reads datasets and a Writer writes datasets, and these terms are analogous to source/destination and input/output.*

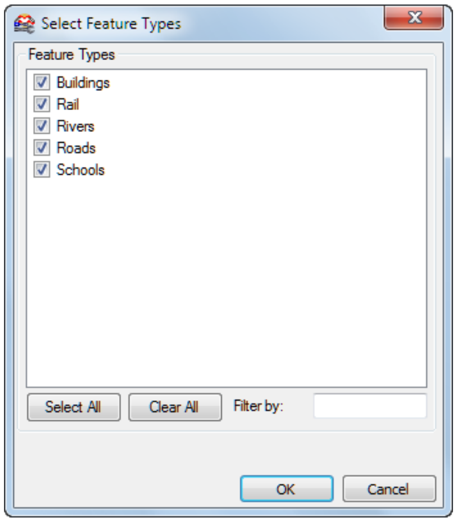
It's always worth checking the parameters at this point. Although most parameters are exposed in the Workbench Navigator window, and can be set there, some parameters affect how the translation workspace will be created and so need adjusting before you accept this dialog.

Feature Types Dialog

Whichever method of workspace creation is used, whenever a Reader (source) Dataset contains a number of different layers the user is prompted to select which layers they want to translate.

This is achieved through the Select Feature Types dialog. In FME 'Feature Type' is another term for 'layer'. Only selected layers show in the workspace.

Here, for example, the user has chosen to include all available layers within the workspace:

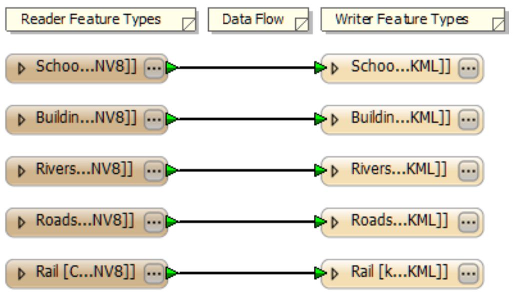


In the Generate Workspace dialog, why might it be useful to set the data format before browsing for the source data?

Try browsing for a dataset before setting the format type and see if you can detect the difference.

The New Workspace

A new workspace reads from left to right, from a Reader, through a transformation, to a Writer. One could also think of these as the Extract-Transform-Load stages of a spatial ETL process.



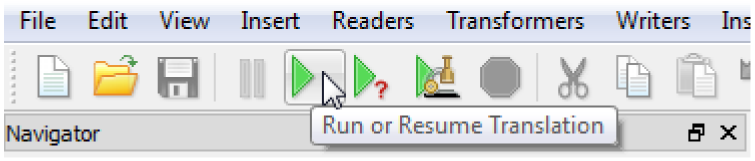
A new workspace resembles this example.

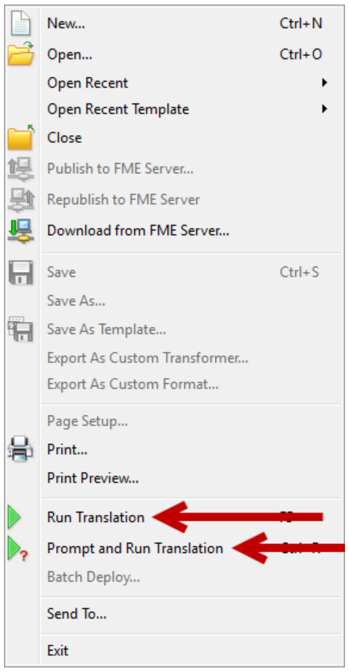
FME places annotation to emphasize the E-T-L structure (Source > Flow > Destination).

Arrows denote the direction of data flow, from source to destination.

Running the Translation

The green arrow (or 'play' button) on the Workbench toolbar starts a translation.





There are also options under **File** on the menu bar to either '**Run**' or '**Prompt and Run**' a translation.

The File menu with run options include shortcut keys that can be used – the F5 key to simply run a translation and Ctrl+R to prompt and run a translation.

Saving the Translation

Workspaces can be saved to a file so that they can be reused at a later date. Simply use **File** > **Save** (shortcut = Ctrl+S) or **File** > **Save As**… to save the translation.

The default file extension is .fmw. Double-clicking a *.fmw file in Explorer starts FME Workbench and opens up the workspace.

Firefighter Mapp says…

'The file menu (File > Open Recent) shows a list of previously used workspaces. This list is expandable to up to a towering 15 entries.'

Functionality: *The 'Run' option carries out a translation using the same parameters and settings used previously. The 'Prompt and Run' option prompts for new values for parameters and settings.*

Regardless of this, however, the 'Run' option must still prompt for parameters that have not yet been filled in and don't have default values.

Translation Results

After running a translation statistics relating to the output results are found in the Workbench log window.

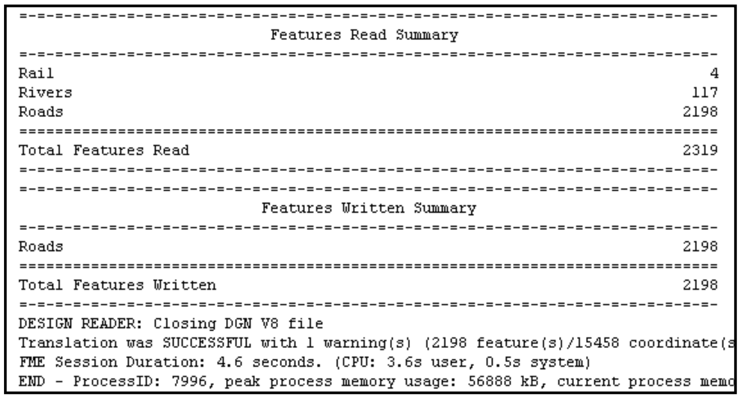
The translation log reveals whether the translation succeeded or failed, how many features were read from the source and written to the destination, and how long it took to perform the translation.

In this example the log file reveals that 2319 features were read from a MicroStation dgn CAD file.

These features were written to a GML output file.

The overall process was a success (with 1 warning).

The elapsed time for the translation was 4.6 seconds.

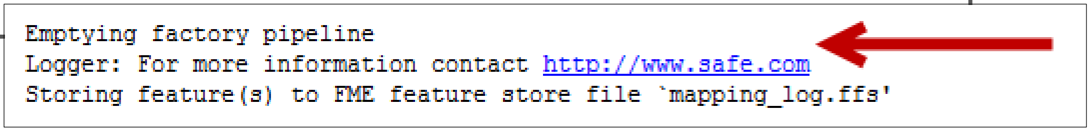


```
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
                          Features Read Summary
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
Rail                                                                        4
Rivers                                                                    117
Roads                                                                    2198
==============================================================================
Total Features Read                                                      2319
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
                         Features Written Summary
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
Roads                                                                    2198
==============================================================================
Total Features Written                                                   2198
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
DESIGN READER: Closing DGN V8 file
Translation was SUCCESSFUL with 1 warning(s) (2198 feature(s)/15458 coordinate(s
FME Session Duration: 4.6 seconds. (CPU: 3.6s user, 0.5s system)
END - ProcessID: 7996, peak process memory usage: 56888 kB, current process memo
```

Terminology: *When a translation is run immediately in Workbench or Quick Translator, without further adjustment, it's known as a 'Quick Translation.'*

Because FME is a 'semantic' translator, with an enhanced data model, the output from a quick translation is as close to the source data in structure and meaning as possible.

Functionality: *Text in the log window that represents a URL or Email address automatically gets a hyperlink added to it. That way you can just click on it in the log window to activate its target.*



```
Emptying factory pipeline
Logger: For more information contact http://www.safe.com
Storing feature(s) to FME feature store file `mapping_log.ffs'
```

Example 1: Quick Translation	
Scenario	FME user; City of Interopolis, Planning Department
Data	City Parks
Overall Goal	Translate the city parks data from MapInfo TAB to GML format
Demonstrates	Quick Translation in FME Workbench
Finished Workspace	C:\FMEData\Workspaces\DAManual\Example1aComplete.fmw C:\FMEData\Workspaces\DAManual\Example1bComplete.fmw

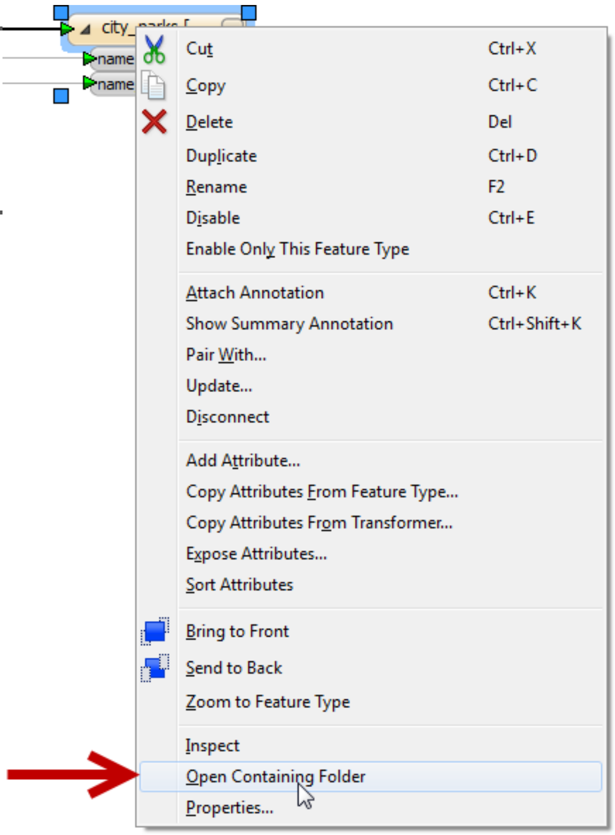
Let's see how intuitive FME's interface is by doing some example translations with minimal instruction.

Start FME Workbench and use it to carry out this conversion of spatial data:

Reader Format	MapInfo TAB (MFAL)
Reader Dataset	*C:\FMEData\Data\Parks\city_parks.tab*
Writer Format	MapInfo MIF/MID
Writer Dataset	*C:\FMEData\Output\DAOutput\*

For now, ignore the Workflow Options and leave the default of 'Static Schema'.
Run the translation. Locate the destination data in Windows Explorer to prove that it's been written.

***Functionality:** You can easily locate the output from a translation by right-clicking on the Feature Type object on the canvas, and choosing the option "Open Containing Folder"*

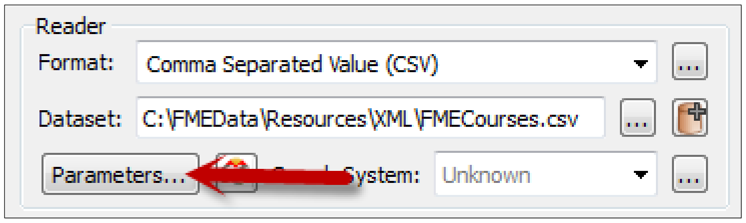


The Generate Workspace dialog has two important buttons that can be used to check the Parameters being used. So now let's try a translation of non-spatial data, using these parameters to affect how the data is read and written.

Start FME Workbench and open the Generate Workspace dialog (Ctrl+G) to define this translation:

Reader Format	Comma Separated Value (CSV)
Reader Dataset	C:\FMEData\Resources\XML\FMECourses.csv
Writer Format	Microsoft Excel
Writer Dataset	C:\FMEData\Output\DAOutput\Courses.xls

Before closing the dialog, click on the Parameters button for the CSV Reader:


Reader

Format: Comma Separated Value (CSV)

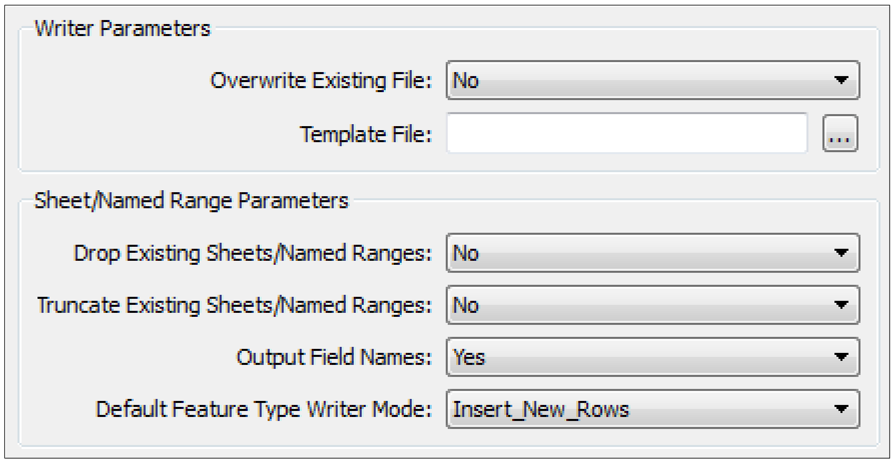
Dataset: C:\FMEData\Resources\XML\FMECourses.csv

Parameters... Coord. System: Unknown

Notice that there are a great number of parameters that can be set at this point. For now click the option “File Has Field Names”. Pay particular attention to the difference that parameter makes to the CSV File Preview.

Click **OK** to close the Reader parameters dialog. Now click the Excel Writer Parameters button.

There are fewer parameters for the Excel writer, but they are no less important. In particular the ability to add data (by setting Overwrite Existing File to No) is very useful, as is the parameter to use an existing spreadsheet as a template file.


Writer Parameters

Overwrite Existing File: No

Template File:

Sheet/Named Range Parameters

Drop Existing Sheets/Named Ranges: No

Truncate Existing Sheets/Named Ranges: No

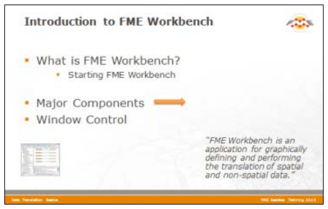
Output Field Names: Yes

Default Feature Type Writer Mode: Insert_New_Rows

Keep the existing parameters and click **OK** to close the dialog. Click **OK** again to generate the workspace. Save the workspace (Ctrl+S) and then run it (Ctrl+R).

Examine the output (and compare it to the input) to ensure it is correct.

Appendix A



Introduction to FME Workbench

- What is FME Workbench?
  - Starting FME Workbench
- Major Components
- Window Control

"FME Workbench is an application for graphically defining and performing the translation of spatial and non-spatial data."

There are many terms used in FME that may not be familiar to you. This Appendix to the training manual is intended to help.

Useful Terminology

Here's a short list of terms that are commonly used in the world of FME:

Canvas
The window in FME Workbench in which Workspaces are created.

Dataset
A set of data with a common theme. A file, folder, database, etc.

Feature
The smallest item of data. May also be known as an object, entity, or element.

Feature Connection
A connection between different objects in a Workspace.

Feature Type
A collection of features in a Dataset. May also be known as a layer, level, table, feature class, category, or feature object.

FME Data Inspector
A tool for inspecting spatial and non-spatial datasets

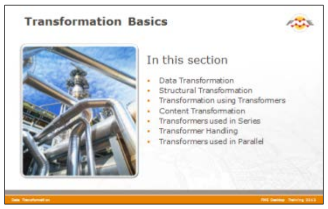
FME Workbench
A tool for creating Workspaces to translate and transform spatial and non-spatial datasets

Transformers
Tools in FME Workbench that are used in a Workspace to transform (manipulate, modify, etc.) features, their geometry, or their attributes.

Workspace
A model for translating and transforming data, defined as a data flow diagram in the Canvas window of FME Workbench.

Data Transformation

Data Transformation



Transformation Basics

In this section

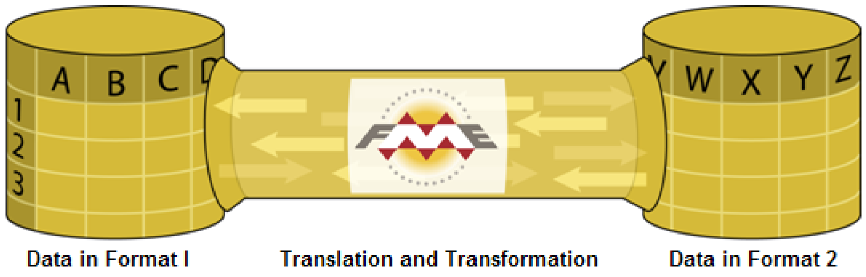
- Data Transformation
- Structural Transformation
- Transformation using Transformers
- Content Transformation
- Transformers used in Series
- Transformer Handling
- Transformers used in Parallel

Data Transformation is the ability to manipulate data during Format Translation – even to the extent of having an output greater than the sum of the inputs!

What is Data Transformation?

Data Transformation is FME's ability to manipulate data. The transformation step occurs during the process of format translation. Data is read, transformed, and then written to the new format; the classic ETL (Extract-Transform-Load) configuration, as shown in the graphic below.

Notice here how the attributes A, B, and C are <u>transformed</u> into a new set of attributes called W, X, Y and Z. The arrows indicate the translation is also bi-directional.



Sometimes FME automatically manipulates the data, as part of its **semantic** capabilities, renaming attributes, adjusting geometry, and splitting up data into several layers in order to ensure that the output from a Format Translation meets the specification of the destination format.

Data Transformation Types

Data transformation can be subdivided into two distinct types: *Structural Transformation* and *Content Transformation*.

Structural Transformation

This type of transformation is perhaps better called 'reorganization'. It refers to the ability of FME to channel data from source to destination in an almost infinite number of arrangements. This includes the ability to merge data, divide data, re-order data, and define custom data structures.

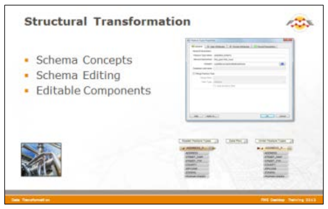
Transforming the structure of a dataset is carried out by manipulating its ***schema***.

Content Transformation

This type of transformation is perhaps better called 'revision'. It refers to the ability to alter the substance of a dataset. Manipulating a feature's geometry or attribute values is the best example of how FME can transform content.

Content transformation can take place independently or alongside structural transformation.

Structural Transformation


Structural Transformation

- Schema Concepts
- Schema Editing
- Editable Components

Transforming a dataset's structure requires knowledge of schemas and how to use FME to manipulate them.

Schema Concepts

A schema is the structure of a dataset or, more accurately, a formal definition of a dataset's structure. The term Data Model may be more familiar, but at Safe Software we stick to the term 'schema'.

Each dataset has its own unique structure (schema) that includes feature types (layers), permitted geometries, user-defined attributes, and other rules that define or restrict its content. One could call this a 'physical' schema since it's a physical representation of the data.

How Does FME Represent Schemas?

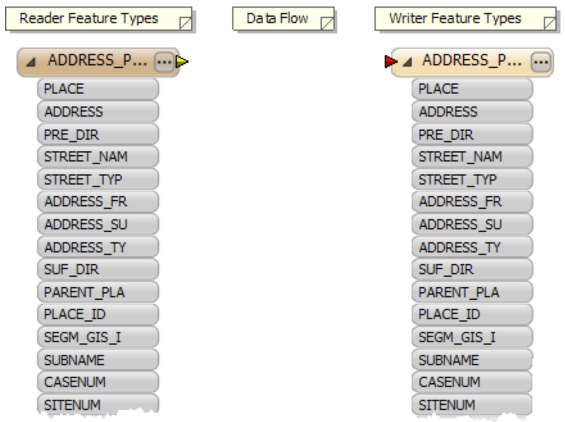
When a new workspace is created, FME scans all of the source datasets. From this it creates a visual representation of the data's schema on the left side of the canvas. On the right side, it creates a visual representation of how this schema will be duplicated in the chosen output format.

Source Dataset Schema **Destination Dataset Schema**

Here are source and destination schemas as they are represented in Workbench.

Each object on the canvas is a separate Feature Type within a dataset.

The workspace reads from left to right.



At this point, the Reader schema represents '*what we have*'; that is, FME's view of the source datasets. The Writer schema represents '*what we want*'; the data required by the user.

To be technical, destination schemas could be called 'logical' schemas because they don't physically exist at this point. Until the workspace is run, they're just one potential output.

By default, the Writer Schema is a mirror image of the source; differences only occur when demanded by limitations of the selected destination format. This allows Quick Translation to occur with no further editing of the translation by the user.

Viewing the Schema in FME Workbench

A schema goes beyond what can be seen on the workspace canvas; there are other components in various dialogs that also represent the structure of a dataset.

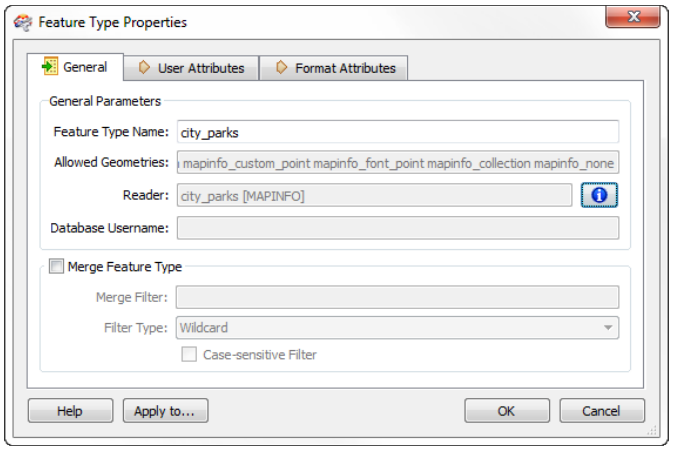
Some parts of the schema relate specifically to a single feature type only. Attributes are one such component. These components are shown in the Properties dialog of a feature type.

The Properties dialog is opened by clicking the Properties Browse button […] at the right side of the feature type.

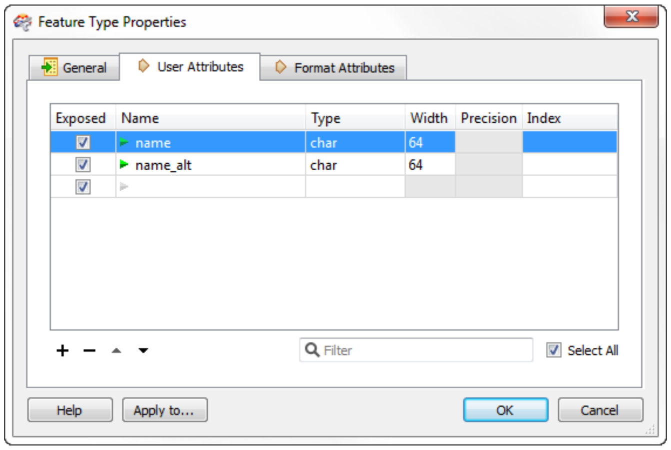
The Feature Type Properties dialog has a number of tabs that show information.

Under the General tab there is the name of the feature type, in this case ADDRESS_POINTS.

Allowed geometry types and the name of the parent dataset for the feature types are shown as well.



General Parameters
Feature Type Name: city_parks
Allowed Geometries: mapinfo_custom_point mapinfo_font_point mapinfo_collection mapinfo_none
Reader: city_parks [MAPINFO]
Database Username:
Merge Feature Type
Merge Filter:
Filter Type: Wildcard
Case-sensitive Filter



Exposed	Name	Type	Width	Precision	Index
✓	name	char	64		
✓	name_alt	char	64		
✓					

The User Attributes tab shows a list of attributes. Each attribute is defined by its name, data type, width, and number of decimal places.

This example shows a Reader feature type. Source attributes cannot be edited (by default) because they represent the physical schema of the data. If they were changed, the schema would no longer match the Reader Dataset.

The Data Type column for an attribute shows only values that match the permitted types for that data format. For example, an Oracle schema permits attribute types of varchar or clob. MapInfo does not support these data types so they would never appear in a MapInfo schema.

Schema Editing

As noted, initially the Writer Schema in a workspace is a mirror image of the source. However, in many cases the user requires the output to have a different data structure.

Schema Editing is the process of altering the destination schema to customize the structure of the output data. One good example is renaming an attribute field in the output. After editing, the source schema still represents '*what we have*', but the destination schema now truly does represent '*what we want*'.

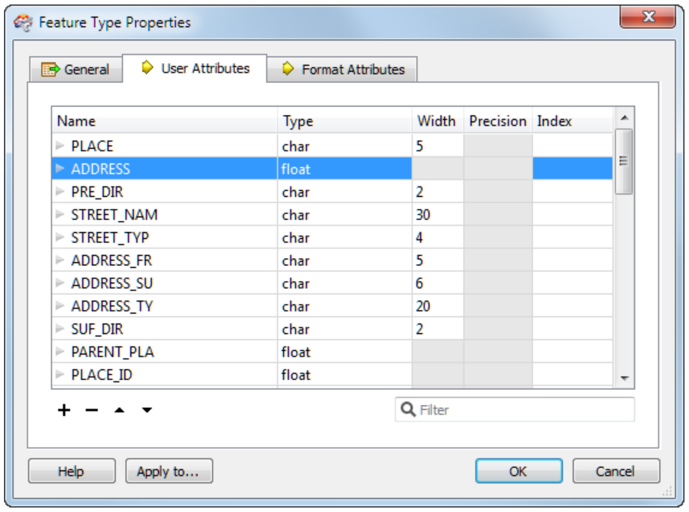
Editable Components

There are a number of edits that can be performed, including, but not limited to the following.

Attribute Renaming

Attributes on the destination schema can be renamed, such as renaming ADDRESS to BUILDING_NUMBER.

To rename an attribute open the Feature Type Properties dialog and click the User Attributes tab. Click the attribute to be renamed and enter the new name.



Feature Type Properties

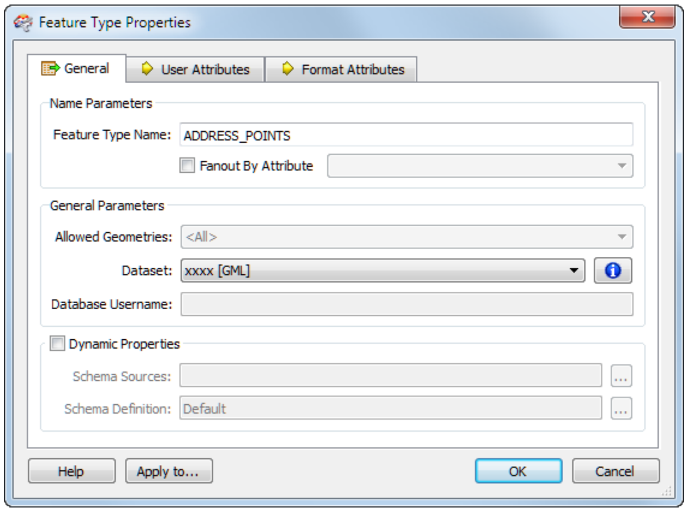
General | User Attributes | Format Attributes

Name	Type	Width	Precision	Index
PLACE	char	5		
ADDRESS	float			
PRE_DIR	char	2		
STREET_NAM	char	30		
STREET_TYP	char	4		
ADDRESS_FR	char	5		
ADDRESS_SU	char	6		
ADDRESS_TY	char	20		
SUF_DIR	char	2		
PARENT_PLA	float			
PLACE_ID	float			

Attribute Type Changes

Any attribute on the writer schema can have a change of type; for example, changing ID from an integer to a float.

To change an attribute type open the Feature Type Properties dialog and click the User Attributes tab. Use the Data Type field to change the type of an attribute.



Feature Type Properties

General | User Attributes | Format Attributes

Name Parameters

Feature Type Name: ADDRESS_POINTS

Fanout By Attribute

General Parameters

Allowed Geometries: <All>

Dataset: xxxx [GML]

Database Username:

Dynamic Properties

Schema Sources:

Schema Definition: Default

Feature Type Renaming

To rename a destination feature type (for example, rename ADDRESS_POINTS to ADDRESSES) open the Feature Type Properties dialog. Click the General tab. Click in the Feature Type Name field and edit the name as required.

Geometry Type Changes

To change the permitted geometry for a feature type, (for example, change the permitted geometries from lines to points) open the Feature Type Properties dialog. Click the General tab. Choose from the list of permitted geometries.

Note*: This field is only available where the format requires a decision on geometry type.*

Schema Mapping

Schema Mapping forms the basis for data restructuring.

In FME Workbench, one side of the workspace shows the source schema (what we have) and the other side shows the destination schema (what we want). Initially the two schemas are automatically joined when the workspace is created, but when edits occur then these connections are usually lost.

Schema mapping is the process of connecting the source schema to the destination schema in a way that ensures the correct Reader features are sent to the correct Writer feature types and the correct Reader attributes are sent to the correct Writer attributes.

Feature Mapping

Feature mapping is the process of connecting source feature types to destination feature types.

Attribute Mapping

Attribute Mapping is the process of connecting source attributes to destination attributes.

Ms. Analyst says…

'You can think of Schema Editing and Mapping as reorganizing data.

A good analogy is a wardrobe full of clothes. When the wardrobe is reorganized you throw out what you no longer need, reserve space for new stuff that you're planning to get, and move existing items into a more usable arrangement.

The same holds true for spatial data restructuring: it's the act of reorganizing data to make it more usable"

In Workbench's intuitive interface, the most common way to make feature type and attribute connections is by **dragging** connecting lines between these parts of the schema.

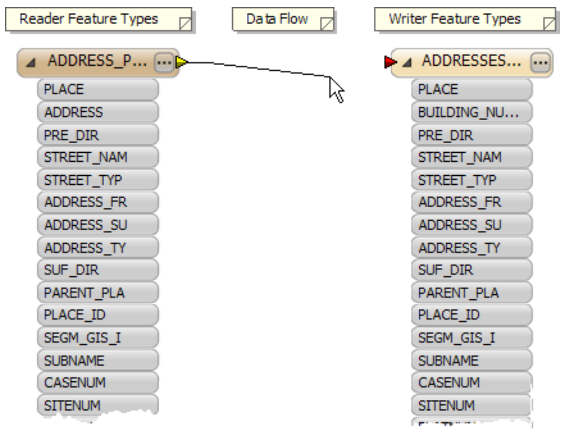
Domain Mapping

Some formats support Domains, which are a way of defining what values are allowed in a particular attribute. With Coded Domains (where each value is given a Code Number), mapping is sometimes required to convert values from the Code number to the descriptive value, or vice versa.

Domain mapping is also required when attributes need to change from one domain to another.

Feature Mapping in FME Workbench

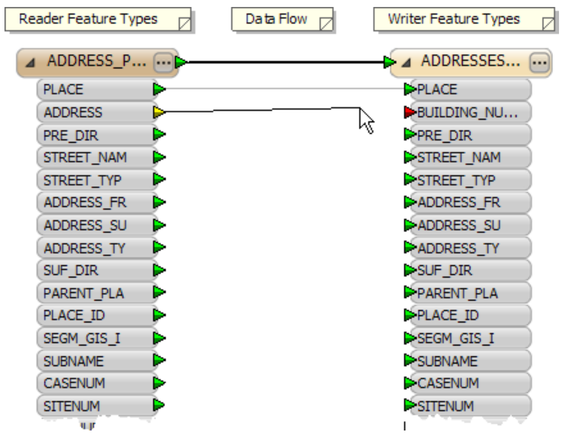
Feature Mapping is carried out by clicking the output port of a source feature type, dragging the arrowhead across to the input port of a destination feature type, and releasing the mouse button.



Here a connecting line from source to destination feature type is created by dragging the arrowhead from the source to the destination.

Attribute Mapping in FME Workbench

Attribute Mapping is performed by clicking the output port of a source attribute, dragging the arrowhead to the input port of a destination attribute, and releasing the mouse button.



Here feature mapping has been carried out already and attribute connections are being made.

Notice the green, yellow, and red color-coding that indicates which attributes are connected.

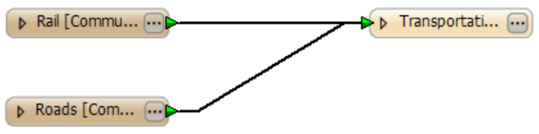
Green ports indicate a connected attribute. Yellow ports indicate a source attribute that's unconnected to a destination. Red ports indicate a destination attribute that's unconnected to a source.

Feature mapping connections (or links) are shown with a thick, black arrow. Attribute mapping connections are shown with a thinner, gray arrow.

Attributes with the same name in source and destination are connected automatically, even though a connecting line might not be visible; the port color is the key.

Names are case-sensitive, therefore *ROADS* is not the same as *roads* or *Roads*

It is permitted to map *'what we have'* to *'what we want'* in any way that is desired.



Here a user needs a single layer called Transportation in their output, and so is merging two input Feature Types (Rail and Roads) into one output Feature Type (Transportation).

Example 2 – Reading Data	
Scenario	FME user; City of Interopolis, Planning Department
Data	CSV format dataset of Cell Phone towers
Overall Goal	Create spatial data and extract information for use in Data Analytics
Demonstrates	Reading data. Using a Transformer. Sending data for inspection.
Starting Workspace	None
Finished Workspace	C:\FMEData\Workspaces\DAManual\Example2Complete.fmw

Description
This example is the first in a series that join together to create a larger FME-based project.

The source data is a CSV dataset containing information about cell phone towers. Fields include signal quality plus an X/Y coordinate for each tower.

The idea is to turn the CSV file contents into proper spatial data and create a set of statistical information from the attributes.

Example 2
Reads the CSV dataset into FME and sets up parameters that control how the data is read. Converts X/Y coordinates into true spatial geometry and sets up sampling of the data.

Example 3
Visually inspects the data against the backdrop of a base map of state/county boundaries.

Example 4
Creates a grid suitable for aggregating the cell towers into groups for analysis

Example 5
Aggregates data from the cell towers onto the grid square that they fall into

Example 6
Reprojects the data so that grid size can be expressed as feet/metres, not decimal degrees.

Example 7/8
Adds a writer to output the data to a MapInfo format, and previews what that output will look like.

Example 9
Calculates statistics about the cell towers for use in Data Analytics workflows

Example 10
Merges the cell tower statistical data onto the spatial (grid) features

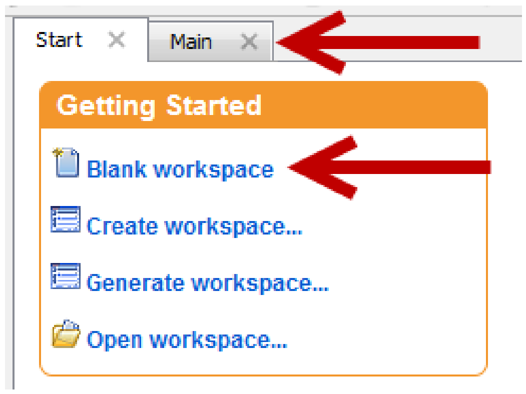
Example 11
Creates published parameters that give the end-user control over the translation process.

Example 12
Provides further user control, cleans up the data schema, and styles the output data symbology

1) Start Workbench
Start FME Workbench if it isn't already.

If you already have a workspace open then select the option "Blank workspace" under "Getting Started" on the Start tab; otherwise just click on the tab marked "Main"

It is common practice to build a translation from scratch, rather than using the Generate Workspace dialog.



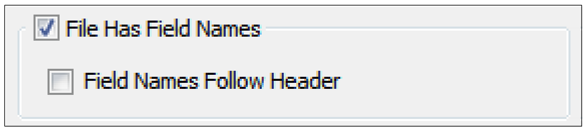
2) Add the CSV File
Open Windows Explorer and browse to the source data at: *C:\FMEData\Resources\DA\CellSignal.csv*

Drag the file from the Explorer window and drop it onto the FME Workbench canvas. The "Add Reader" dialog will open and be filled in automatically with these parameters:

Reader Format	Comma Separated Value (CSV)
Reader Dataset	*C:\FMEData\Resources\DA\CellSignal.csv*

Before the translation is created, we need to check the parameters for this Reader. Click on the "Parameters…" button to open the parameters dialog.

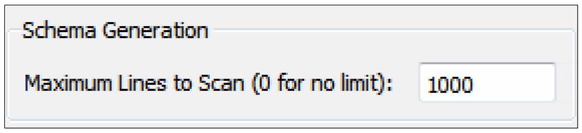
Because the first line contains the field names for the data, put a check mark in the box labelled "File Has Field Names".



✓ File Has Field Names

☐ Field Names Follow Header

If all your datasets have field names then set this as the default and save time in the future.



Schema Generation

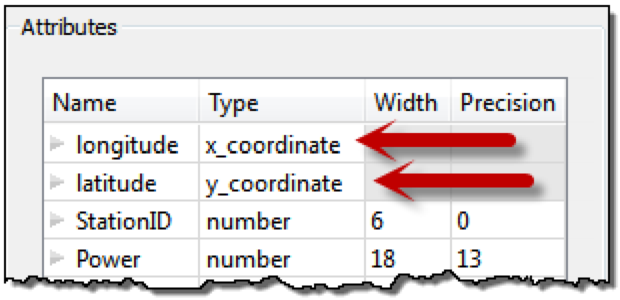
Maximum Lines to Scan (0 for no limit): 1000

Now set the "Maximum Lines to Scan" parameter to 1000. This speeds up creation of the workspace by limiting the amount of data scanned to determine the schema.

Because the CSV data includes spatial information – in the form of longitude and latitude attributes – we can have FME convert the data directly to a spatial form.

To do so, locate "longitude" and "latitude" in the Attributes section of the dialog.

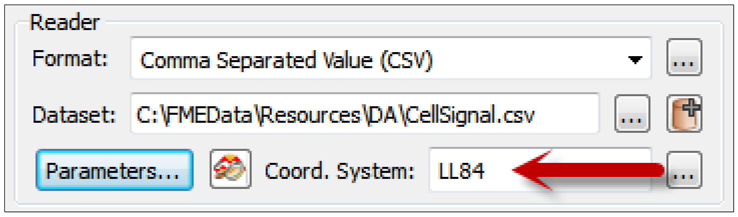
Click in the Type field and change the attribute types to x_coordinate and y_coordinate respectively.



Attributes

Name	Type	Width	Precision
longitude	x_coordinate		
latitude	y_coordinate		
StationID	number	6	0
Power	number	18	13

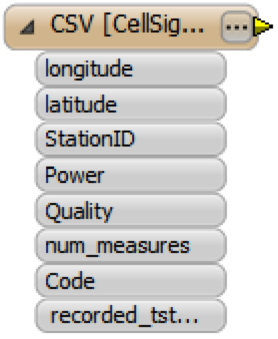
Click **OK** to close the parameters dialog. Back in the Add Reader dialog, set the Coordinate System to LL84. Like a data format you can do this by typing in the name, selecting it from the drop-down list, or browsing for it in a gallery (click the […] button).


Reader
Format: Comma Separated Value (CSV)
Dataset: C:\FMEData\Resources\DA\CellSignal.csv
Parameters...
Coord. System: LL84

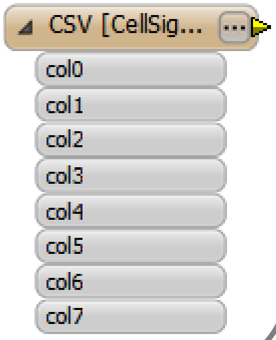
Leave the “Workflow Options” parameter as “Individual Feature Types”, although the “Single Merged Feature Types” option would also work for this translation.

Click OK to close the dialog and add the Reader to the empty workspace.

The Feature Type added to the workspace should look like this:



If it looks like this then you forgot to check the “File Has Field Names” parameter.



If you do get this incorrect, you can fix the problem by deleting and then replacing the Reader. Ask your instructor if you need help.

3) Save the Workspace

It’s important to save your workspace early on in the design process. This creates a *recovery file* and enables Workbench to back up the workspace periodically. Then, should anything untoward occur - like a power failure or operating system crash – you will be able to recover unsaved changes.

So, save the workspace using File > Save from the menubar or the shortcut, Ctrl+S.

Terminology: *Feature Type is the FME term that describes an identifiable subset of records. Common alternatives for this term are 'layer', 'table', 'feature class', and 'object class'.*

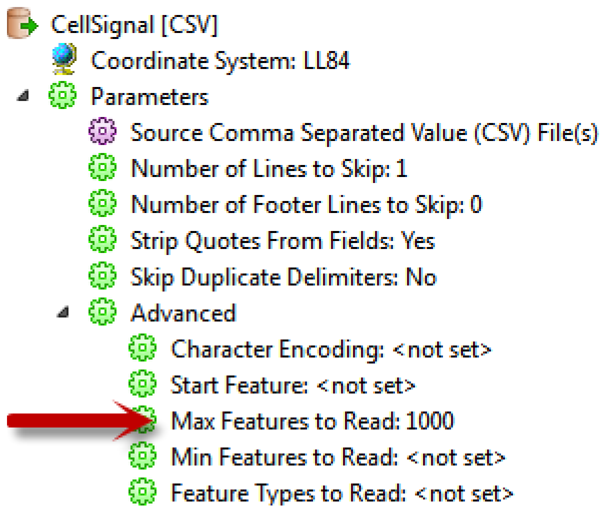
Each layer of data in a dataset is represented by a separate Feature Type in the workspace. So a database with tables "Roads", "Rivers", and "Rail" is depicted by three Feature Types with those names.

However, because CSV datasets have no way of internally subdividing data into layers, we call it a "fixed schema" dataset. There can be no layers in a CSV file so we simply call the Feature Type "CSV".

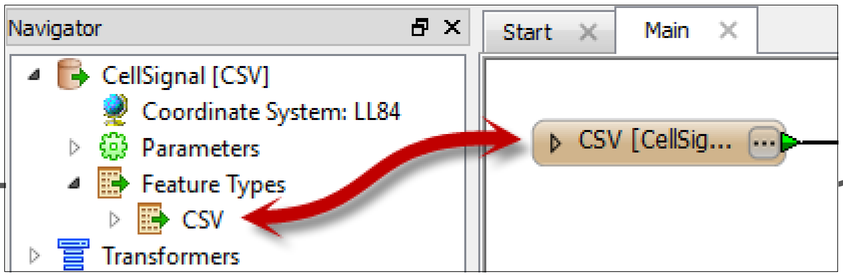
4) Limit the number of features read
For this example, we only want to read in some sample data – to ensure the translation works before reading the entire file.

In the Navigator window, click on the expand icons to show the Advanced Parameters for the CSV Reader.

Double-click on "Max Features to Read" and set it to 1000.


CellSignal [CSV]
Coordinate System: LL84
Parameters
Source Comma Separated Value (CSV) File(s)
Number of Lines to Skip: 1
Number of Footer Lines to Skip: 0
Strip Quotes From Fields: Yes
Skip Duplicate Delimiters: No
Advanced
Character Encoding: <not set>
Start Feature: <not set>
Max Features to Read: 1000
Min Features to Read: <not set>
Feature Types to Read: <not set>

Terminology: *As you'll see in the next section, there is a direct connection between the Feature Types on the canvas and the Reader in the Navigator window. Any Reader parameters you change in the Navigator have an effect on how the Feature Type is read.*



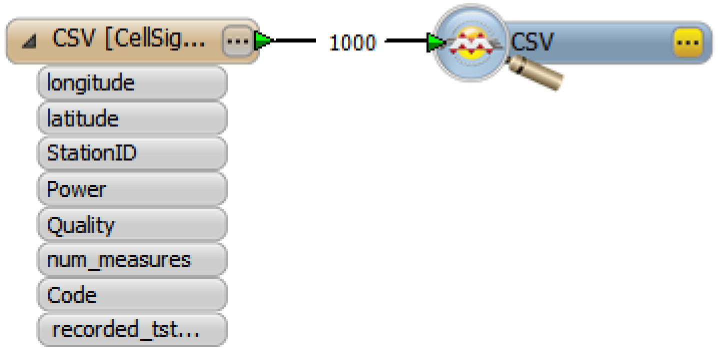
5) Add Inspector Transformer
A workspace can be run without having a Writer with which to create output. Instead the data can be transmitted directly to the FME Data Inspector application.

Right-click on the title bar of the Reader feature type and select the option Connect Inspectors. An Inspector transformer is connected to the output port(s) of the feature type.

Now, when data reaches this point, it is sent to the FME Data Inspector.

6) Run the Translation
Click on the green play button on the toolbar. Alternative methods are File > Run (from the menubar) or the F5 key.

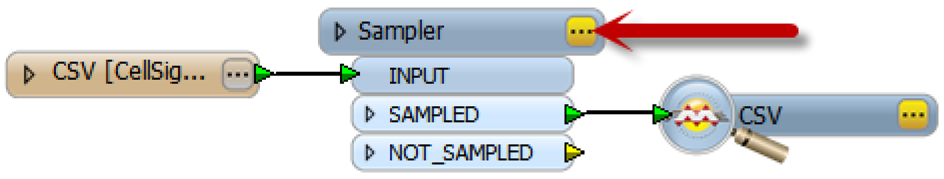
The data is read, converted from non-spatial to spatial, and sent to the FME Data Inspector, which will open automatically at the end of the translation.



7) Advanced Task
An alternative to the "Max Features to Read" parameter is a transformer called the Sampler.

As an advanced task, reset the Max Features to Read parameter (delete its value).

Click on the connection between feature type and Inspector and type "Sampler" to place a Sampler transformer. Choose the SAMPLED port when prompted.



Now click the yellow […] button to open the parameters dialog for the Sampler and examine the different parameters. Set up the transformer to read only the first 1,000 features.

Now run the translation again.

Having looked at the Sampler parameters, and having run the workspace, what do you think the relative advantages of each technique are? Discuss with your instructor.

Introduction to Data Inspection

Data Inspection

In this section

- What is Data Inspection?
- Introduction to FME Universal Viewer
- Using FME Universal Viewer

Inspecting spatial data prior to, during, or after the translation is a helpful way to verify that the process is operating as expected.

What is Data Inspection?
One piece of FME marketing material once stated:

> *'To ensure that you're dealing with the right information you need a clear view of your data at every stage of the transformation process.'*

Data Inspection meets this need. It is the act of viewing data for verification and debugging purposes, before, during, or after a translation.

What Can Be Inspected?
A number of different facets to spatial data may be inspected, including the following:

- **Geometry**: Is the geometry in the correct spatial location? Are the geometry types correct?
- **Symbology**: Is the color, size, and style of each feature correct?
- **Attributes**: Are all the required attributes present? Are all integrity rules being followed?
- **Data Format**: Is the data in the expected format?
- **Data Schema**: Is the data subdivided into the correct layers, categories or classes?
- **Data Quantity**: Does the data contain the correct number of features?
- **Process Output**: Has the translation process restructured the data as expected?

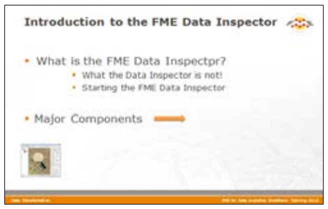
Chef Bimm says…

'I have a great recipe for loading CAD files into a Building Information Model. Previewing the ingredients… I mean data… lets me detect problems before they affect the translation.

Features in the wrong source layer could need the whole process to be repeated. Data Inspection saves me that hassle.'

See Appendix A for a list of which geometries the FME data model supports.

Introduction to the FME Data Inspector


Introduction to the FME Data Inspector
- What is the FME Data Inspectpr?
  - What the Data Inspector is not!
  - Starting the FME Data Inspector
- Major Components

The FME Data Inspector is a utility for viewing spatial data.

As you may have noticed, FME Workbench does not include any data viewing functionality. This inspection role is carried out by a complementary application, the FME Data Inspector.

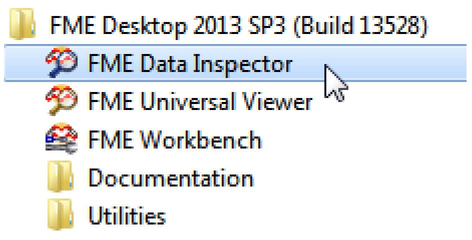
What is the FME Data Inspector?
The FME Data Inspector (sometimes called the 'Viewer' or 'Visualizer') is a utility that allows viewing of data in any of the FME supported formats. It is used primarily to preview data before translation or to verify it after translation.

The Data Inspector can also be used to check data at any point during a translation; as you use FME you'll find this is useful for step-by-step examination of complex translations.

FME Data Inspector is tied closely to FME Workbench so that Workbench can send data directly to the Inspector.

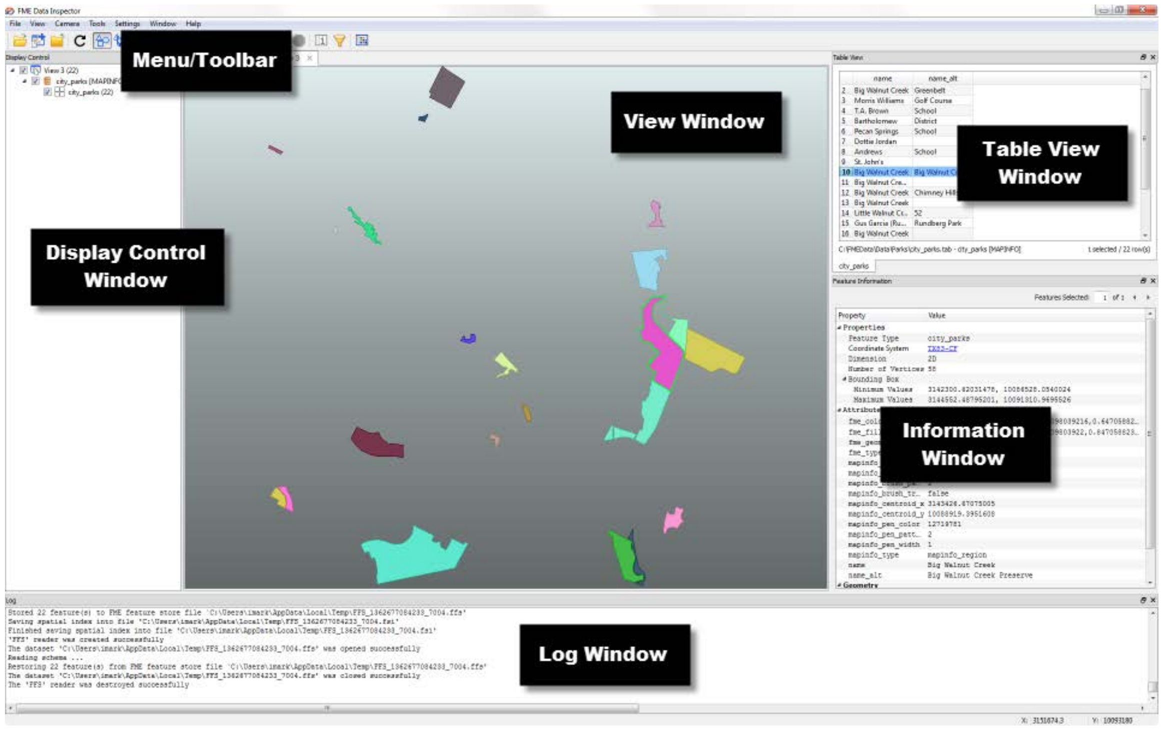
What the FME Data Inspector Is Not!
FME Data Inspector isn't designed to be a form of GIS or mapping application. It has no all-around analysis functionality, and the tools for symbology modification and printing are rudimentary and intended for data validation rather than producing map output.

Starting the FME Data Inspector
To start FME Data Inspector, from the Windows start menu click **FME Desktop**, then on the sub-menu click **FME Data Inspector**.



Major Components of the FME Data Inspector

When the FME Data Inspector is started, and a dataset is opened, it looks something like this:



	name	name_alt
2	Big Walnut Creek	Greenbelt
3	Morris Williams	Golf Course
4	T.A. Brown	School
5	Bartholomew	District
6	Pecan Springs	School
7	Dottie Jordan	
8	Andrews	School
9	St. John's	
10	Big Walnut Creek	Big Walnut C
11	Big Walnut Cre...	
12	Big Walnut Creek	Chimney Hill
13	Big Walnut Creek	
14	Little Walnut Cr...	52
15	Gus Garcia (Ru...	Rundberg Park
16	Big Walnut Creek	

C:\FMEData\Data\Parks\city_parks.tab - city_parks [MAPINFO] 1 selected / 22 row(s)

city_parks

Property	Value
Properties	
Feature Type	city_parks
Coordinate System	TX83-CF
Dimension	2D
Number of Vertices	58
Bounding Box	
Minimum Values	3142300.82031478, 10086528.0540024
Maximum Values	3144562.48795201, 10091310.9695626
Attribute	
fme_col	98039216,0.64705882...
fme_fil	9803922,0.647058823...
fme_geo	
fme_type	
mapinfo_	
mapinfo_	
mapinfo_	2
mapinfo_brush_tr...	false
mapinfo_centroid_x	3143426.87075005
mapinfo_centroid_y	10088919.3951608
mapinfo_pen_color	12719781
mapinfo_pen_patt...	2
mapinfo_pen_width	1
mapinfo_type	mapinfo_region
name	Big Walnut Creek
name_alt	Big Walnut Creek Preserve
Geometry	

```
Stored 22 feature(s) to FME feature store file 'C:\Users\imark\AppData\Local\Temp\FFS_1362677084233_7004.ffs'
Saving spatial index into file 'C:\Users\imark\AppData\Local\Temp\FFS_1362677084233_7004.fsi'
Finished saving spatial index into file 'C:\Users\imark\AppData\Local\Temp\FFS_1362677084233_7004.fsi'
'FFS' reader was created successfully
The dataset 'C:\Users\imark\AppData\Local\Temp\FFS_1362677084233_7004.ffs' was opened successfully
Reading schema ...
Restoring 22 feature(s) from FME feature store file 'C:\Users\imark\AppData\Local\Temp\FFS_1362677084233_7004.ffs'
The dataset 'C:\Users\imark\AppData\Local\Temp\FFS_1362677084233_7004.ffs' was closed successfully
The 'FFS' reader was destroyed successfully
```

X: 3131674.3 Y: 10093180

Menu bar and Toolbar

The menu bar and toolbar contain a number of tools. Some are for navigating around the View window, some control administrative tasks such as opening or saving a dataset, and others are for special functionality such as selective filtering of data or the creation of dynamic attributes.

View Window

The View window is the spatial display area of the FME Data Inspector. Multiple views of different datasets may be opened at any one time.

Display Control Window

The Display Control window shows a list of the open datasets and their feature types. Tools here let users turn these on or off in the display, alter their symbology, and adjust the display order.

Feature Information Window

When users query a feature in the View window, information about that feature is shown in the Information window. This information includes the feature's feature type, attributes (both user and format attributes), coordinate system and details about its geometry.

Log Window

The Log window reports information relating to the reading and look of a dataset that can be used to confirm whether data has been read correctly. Some functions on the toolbar also generate messages in the Log window.

Table View Window

The Table View window shows attribute information for multiple features in a spreadsheet style.

Using FME Data Inspector

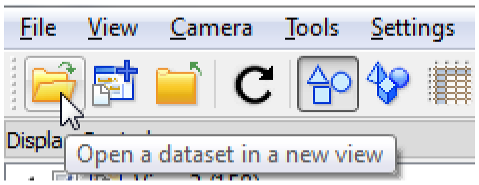
Using the FME Data Inspector

- Viewing Data
  - Opening a dataset
  - Adding a dataset
- Inspecting Data
  - Navigating the Inspector
  - Querying features
  - Table View
  - Filtering Data

With FME Data Inspector it's easy to open and view any number of datasets and to query features within them.

Viewing Data

FME Data Inspector provides two methods for viewing data: opening or adding.

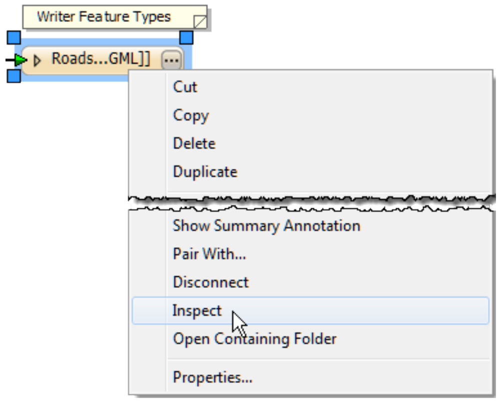


Opening a Dataset

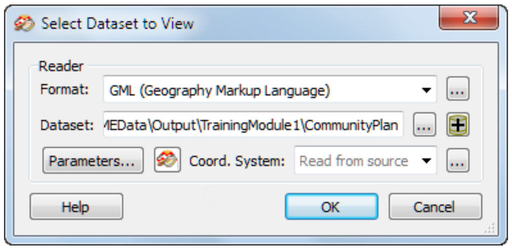
Datasets can be *opened* in the FME Data Inspector in a number of ways.

- Selecting **File** > **Open Dataset** from the menu bar
- Selecting the toolbar button Open Dataset.
- Dragging and Dropping a file onto any window (*except the View window*)
- From within Workbench

Opening data from within FME Workbench is achieved by simply right-clicking on a canvas feature type (either source or destination) and choosing the option 'Inspect'.



All of these methods cause a dialog to open in the FME Data Inspector in which to define the dataset to view. In the case of the Drag-and-Drop and Workbench Inspect methods, the dialog is automatically filled in by FME.


Select Dataset to View

Reader

Format: GML (Geography Markup Language)

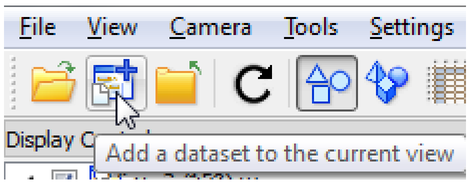
Dataset: MEData\Output\TrainingModule1\CommunityPlan

Parameters... Coord. System: Read from source

Adding a Dataset

Opening a dataset causes a new View tab to be created and the data displayed. To open a dataset within an existing view tab requires use of tools to *add* a dataset.

- Selecting **File** > **Add Dataset** from the menu bar
- Selecting the toolbar button Add Dataset
- Dragging and Dropping a file onto *the view window*



Inspecting Data

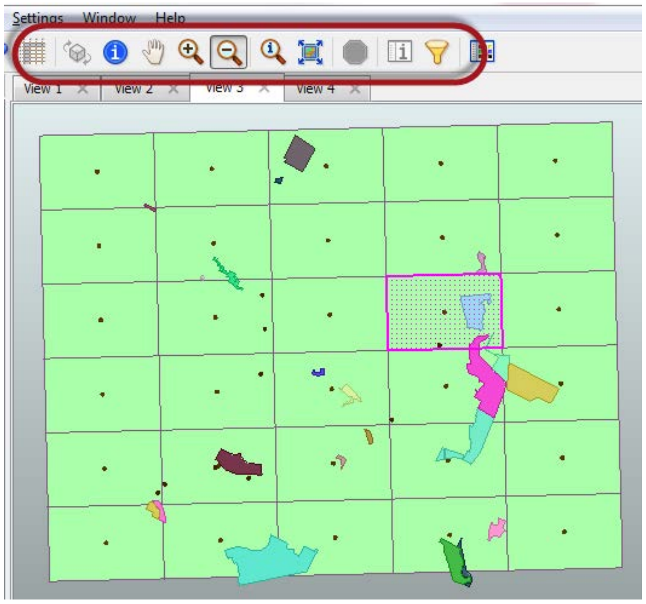
Once data has been opened in the FME Data Inspector, there are a number of tools available for altering the view or querying features.

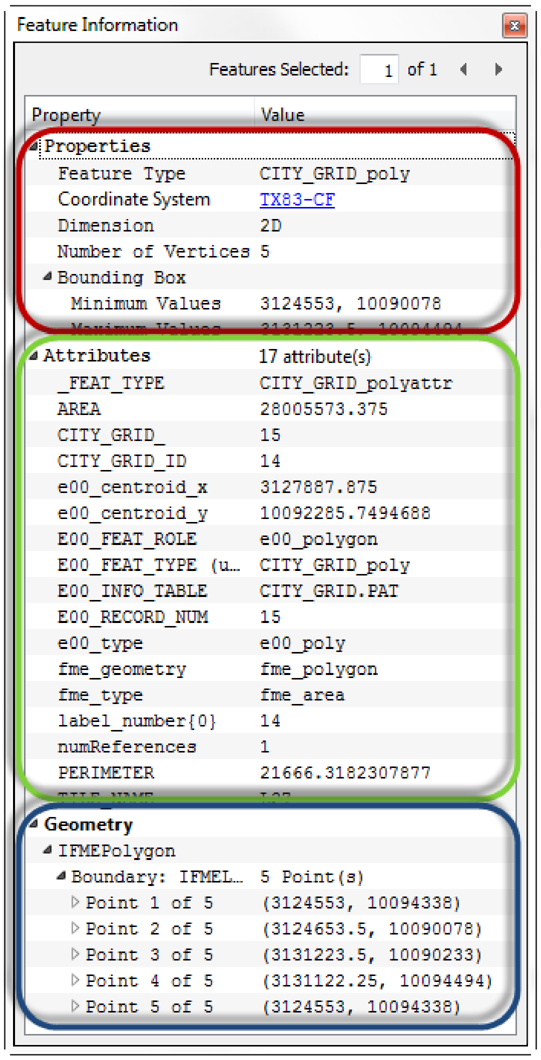
Windowing tools are:

- Pan
- Zoom In
- Zoom Out
- Zoom to a selected feature
- Zoom to the full extent of the data
- Rotate/Orbit (3D data only)

Querying tools are

- Query an individual feature
- Query all non-geometry features
- Query with conditions





Feature Information

Features Selected: 1 of 1

Property	Value
Properties	
Feature Type	CITY_GRID_poly
Coordinate System	TX83-CF
Dimension	2D
Number of Vertices	5
Bounding Box	
Minimum Values	3124553, 10090078
Maximum Values	3131223.5, 10094494
Attributes	17 attribute(s)
_FEAT_TYPE	CITY_GRID_polyattr
AREA	28005573.375
CITY_GRID_	15
CITY_GRID_ID	14
e00_centroid_x	3127887.875
e00_centroid_y	10092285.7494688
E00_FEAT_ROLE	e00_polygon
E00_FEAT_TYPE (u...	CITY_GRID_poly
E00_INFO_TABLE	CITY_GRID.PAT
E00_RECORD_NUM	15
e00_type	e00_poly
fme_geometry	fme_polygon
fme_type	fme_area
label_number{0}	14
numReferences	1
PERIMETER	21666.3182307877
TILE_NAME	[illegible]
Geometry	
IFMEPolygon	
Boundary: IFMEL...	5 Point(s)
Point 1 of 5	(3124553, 10094338)
Point 2 of 5	(3124653.5, 10090078)
Point 3 of 5	(3131223.5, 10090233)
Point 4 of 5	(3131122.25, 10094494)
Point 5 of 5	(3124553, 10094338)

Querying a single feature updates the display in the Information window:

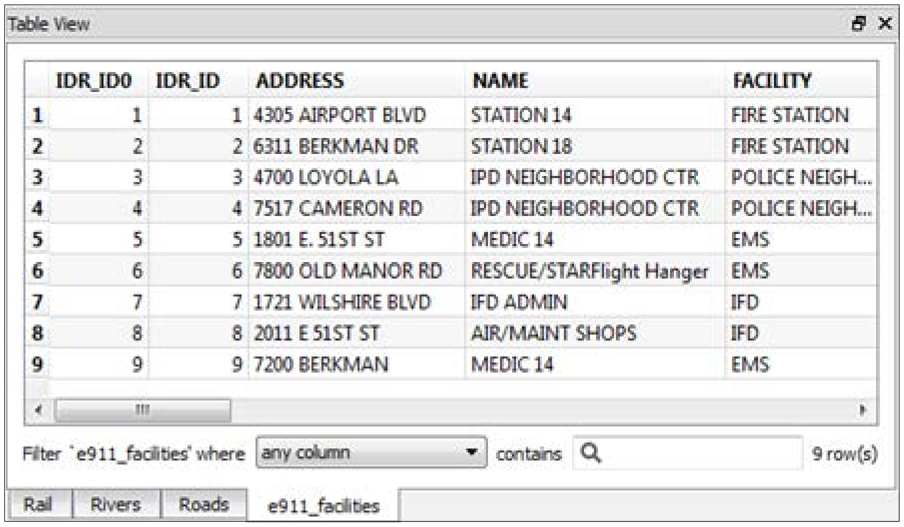
The upper part reports on the general properties of the feature; for example which type (layer) it belongs to and which coordinate system it is in.

The middle part reports the attributes associated with the feature. This includes user attributes and format attributes (for example *fme_type*).

The lower part reports the geometry of the feature. It lists all of the individual geometries that make up the feature, and all of the coordinates that are part of those geometries. It also includes details about textures attached to features.

Table View Window

The Table View window is a spreadsheet-like view of the user attributes that exist on all features on a particular feature type. Compared to the Feature Information Window it displays less information, but in a nicer way and for multiple features simultaneously.

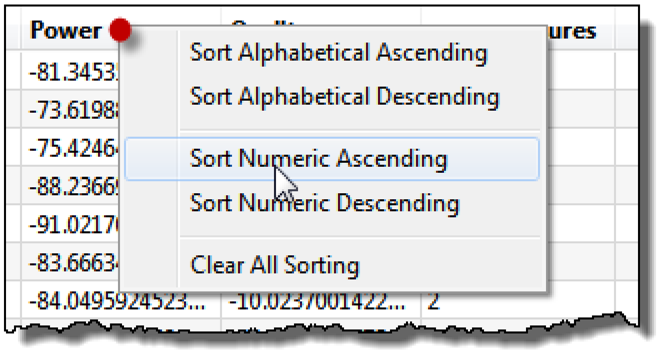


	IDR_ID0	IDR_ID	ADDRESS	NAME	FACILITY
1	1	1	4305 AIRPORT BLVD	STATION 14	FIRE STATION
2	2	2	6311 BERKMAN DR	STATION 18	FIRE STATION
3	3	3	4700 LOYOLA LA	IPD NEIGHBORHOOD CTR	POLICE NEIGH...
4	4	4	7517 CAMERON RD	IPD NEIGHBORHOOD CTR	POLICE NEIGH...
5	5	5	1801 E. 51ST ST	MEDIC 14	EMS
6	6	6	7800 OLD MANOR RD	RESCUE/STARFlight Hanger	EMS
7	7	7	1721 WILSHIRE BLVD	IFD ADMIN	IFD
8	8	8	2011 E 51ST ST	AIR/MAINT SHOPS	IFD
9	9	9	7200 BERKMAN	MEDIC 14	EMS

Filter `e911_facilities' where any column contains 9 row(s)

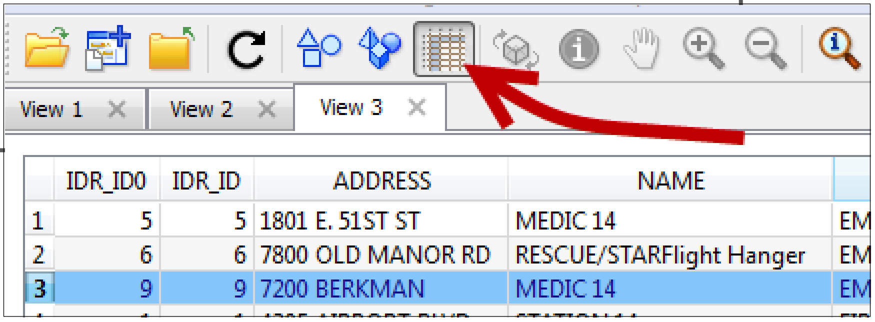
A different tab is available for each of the Features Types open in the view window. Clicking on a tab shows the features for that Feature Type. Data for any tab can be filtered using the Filter fields just above the tab name.

Like any such tool, the columns can be resized by dragging the separator bar, and data can be sorted by clicking on the column header. Right-clicking on the column header allows you to choose different methods of sorting:



Additionally, the View Window is connected to the Table View, so that features queried in the View Window are highlighted in the Table View, and vice versa.

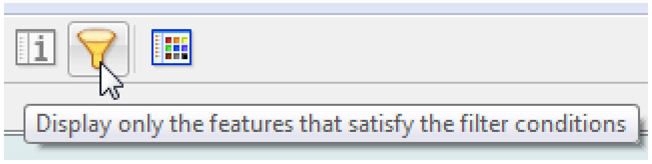
The main View Window can be made to display the Table View– rather than spatial data – by using this tool on the toolbar. To revert to a spatial view simply click on either of the two buttons to its left (the 2D/3D view buttons)



	IDR_ID0	IDR_ID	ADDRESS	NAME	
1	5	5	1801 E. 51ST ST	MEDIC 14	EM
2	6	6	7800 OLD MANOR RD	RESCUE/STARFlight Hanger	EM
3	9	9	7200 BERKMAN	MEDIC 14	EM

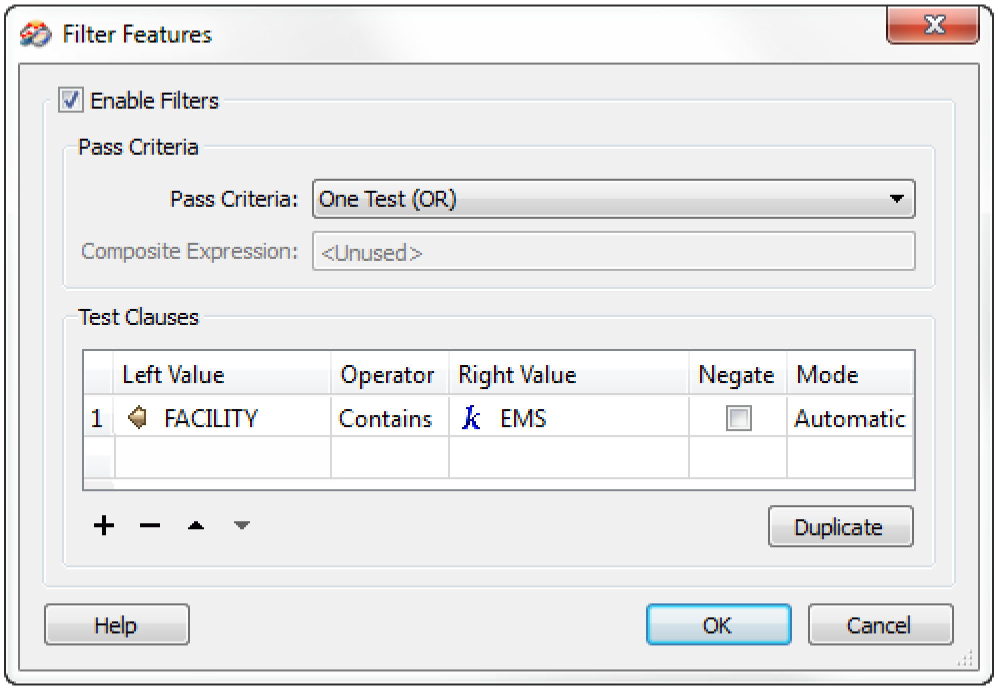
Filtering Data

The Filter button on the toolbar opens up a dialog within which conditions can be set on which spatial features to display.


Display only the features that satisfy the filter conditions

The dialog is similar to the Tester transformer (if you are familiar with that). It can be used to set up conditions around attributes or FME functions, and has a number of different operators such as equals (=), greater than (>), begins with, contains, etc.

For example, here the user is setting up a filter to only display EMS facilities in a 911 dataset:



Enable Filters ✓

Pass Criteria

Pass Criteria: One Test (OR)

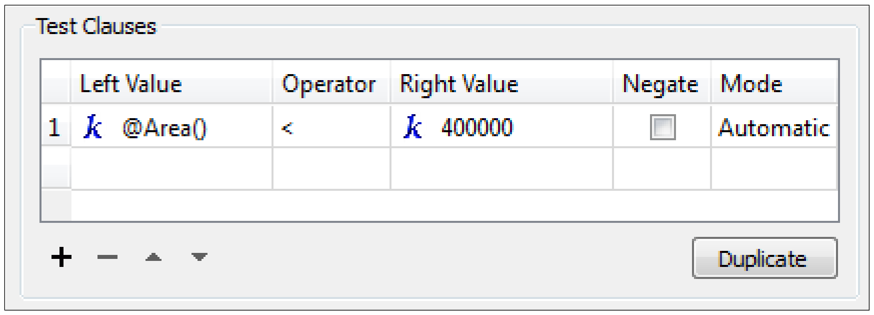
Composite Expression: <Unused>

Test Clauses

	Left Value	Operator	Right Value	Negate	Mode
1	FACILITY	Contains	EMS	☐	Automatic

The filtering tool is applied to ALL feature types, not just a single one.

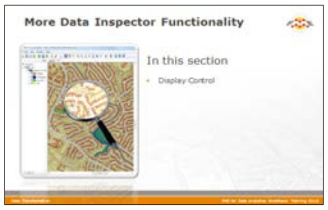
Here the user has set up a test using an FME Function. They are filtering the data to only display features with an area of less than 400,000 (the units being referred to will depend on what coordinate system is used).



Test Clauses

	Left Value	Operator	Right Value	Negate	Mode
1	@Area()	<	400000	☐	Automatic

More Data Inspector Functionality


More Data Inspector Functionality
In this section
- Display Control

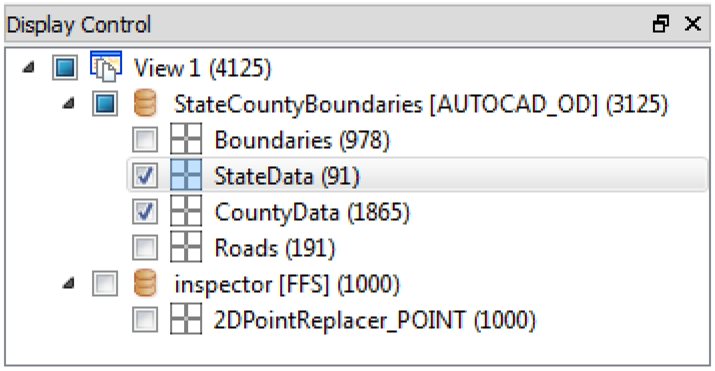
The FME Data Inspector has a number of controls to assist in showing the data in an orderly manner.

Display Control

Managing the display of features is carried out in the Display Control window.

Datasets and feature types are shown in the same order in the view window as they appear in the Display Control window.

Each Dataset and feature type can be dragged above any other to promote its display order in the View window.


Display Control
- ☑ View 1 (4125)
  - ☑ StateCountyBoundaries [AUTOCAD_OD] (3125)
    - ☐ Boundaries (978)
    - ☑ StateData (91)
    - ☑ CountyData (1865)
    - ☐ Roads (191)
  - ☐ inspector [FFS] (1000)
    - ☐ 2DPointReplacer_POINT (1000)

Feature Types can only be ordered within their container Dataset. You cannot mix them up by having one feature above another dataset, with the rest of the feature types below.

Display Status

Each level of the Display Control window has a checkbox to turn data on and off at that level. Turning off a higher level in the hierarchy turns off everything below it.

For example, clearing the checkbox for View 1 turns off data for the entire view. Clearing a dataset checkbox turns off data in the view for that particular dataset only.

The Display Control window also gives a count of how many features there are for each View/Dataset/Feature Type. Filtering does not affect these numbers.

Symbology

Each feature type can be assigned a different color or style that applies to all geometries. At a lower level each separate geometry type can be assigned a different color or style.

Mr. R.G.B. Color says…

'Click on the color icon: ⊞

It will open a dialog in which to change feature color. Be sure to select the Override Source option first!'

Example 3: Data Inspection	
Scenario	FME User; City of Interopolis, Planning Department
Data	CSV format dataset of Cell Phone Towers, AutoCAD Map3D Object Data dataset
Overall Goal	Inspect results of example 2
Demonstrates	Data Inspection

The previous example opened its results in the FME Data Inspector. Now let's use that application to study the results and what they contain.

1) Use Windowing Tools
Use the windowing tools in the Data Inspector to zoom into the data points.

Functionality: *You can use the shift and control keys to switch from query mode to zoom mode, without having to use the toolbar.*

2) Query a Feature
Query a feature by clicking on to it. Look in the Feature Information window to find out details about its properties, attributes, and geometry.

3) Add a Dataset
To act as a reference to locate the new data, let's add a map showing local government boundaries.

Choose File > Add Dataset from the menubar (or use an alternate method such as Ctrl+D). In the Add Dataset dialog, enter the following:

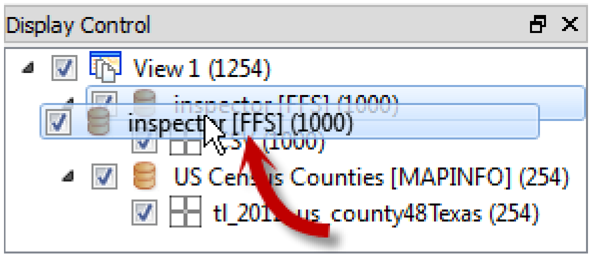
Reader Format	MapInfo TAB (MFAL)
Reader Dataset	*C:\FMEData\Data\GovtBoundaries\US Census Counties.zip*

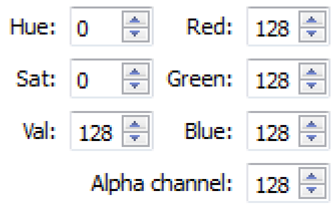
Note that, as this is a zip file, you'll need to change the file extension you are browsing for.

Click OK to add the dataset then click the "Zoom to full extents" button to get the full picture.

4) Set Symbology
If the county boundaries overlay the point features then there are two solutions.

Firstly you can drag the point features above the counties in the Display Control Window.



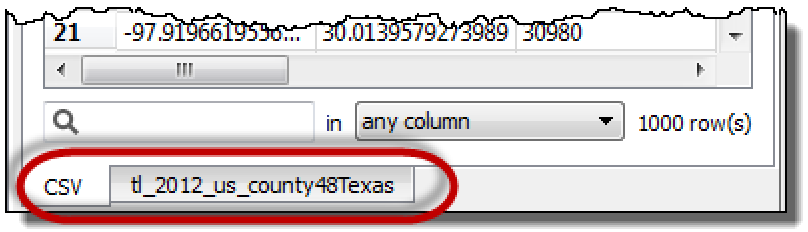


Hue:	0	Red:	128
Sat:	0	Green:	128
Val:	128	Blue:	128
		Alpha channel:	128

Alternatively, you can change the drawing style of the county features by reducing the Alpha Channel value.

5) Inspect Attributes
Examine data in the Table View window. To do so, click the toolbar button to switch it into the main View Window.

Notice the different tabs for the data received from Workbench and for the layer in the MapInfo TAB dataset.



Click the different tabs in turn, to inspect the attribute data for each of the Feature Types. Notice what happens when no attribute data is available.

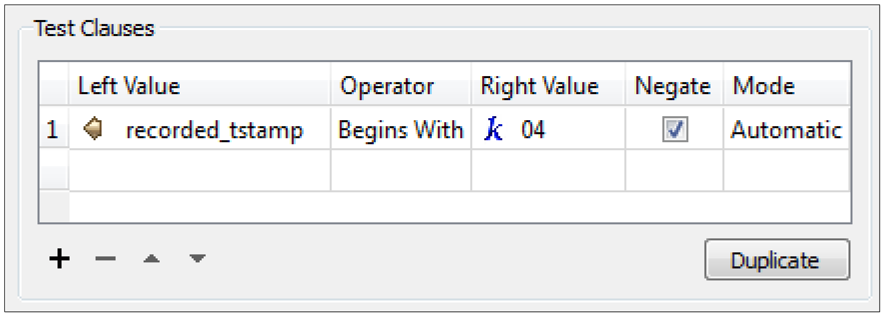
Click the CSV tab (which represents the name of the Inspector transformer added in Workbench). Click on the column header named “recorded_tstamp” to sort data in order of date.

6) Locate Features
Switch back to the 2D spatial view. Click on the top record in the Table View window and see where it is highlighted on screen. This will be the feature with the oldest timestamp.

Click on some features in the View Window to see them highlighted in the Table View.

7) Filter Data
Click the funnel icon in the toolbar to open the dialog for filtering data.

Set up a test clause that shows data from the 4th December. Then use the Negate option to show data that is not time-stamped the 4th of December.


Test Clauses

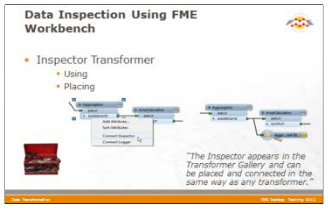
	Left Value	Operator	Right Value	Negate	Mode
1	recorded_tstamp	Begins With	04	✓	Automatic

8) Advanced Task
The FME Data Inspector allows background data to be added to the display.

Select Tools > FME Options from the Inspector menubar.

Experiment with adding background data; either Stamen Maps or – if you have an account – ArcGIS online. Notice that you need to reopen the main datasets (or re-run the workspace) in order to view the background data.

Data Inspection Using FME Workbench

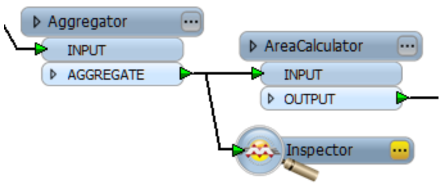


Besides 'Redirect to Inspection Application', Workbench can route data to FME Data Inspector from individual transformers.

Using an Inspector Transformer

An *Inspector* is a Workbench transformer – with its own distinctive look and style – that causes data entering it to be directed to FME Data Inspector.

An *Inspector* transformer differs from the Redirect to Inspection Application setting because the transformer can be applied at any point in a translation (not just at the very end) and does not prevent the data being output to the writer. It also lets a user be more selective about which features should be inspected.

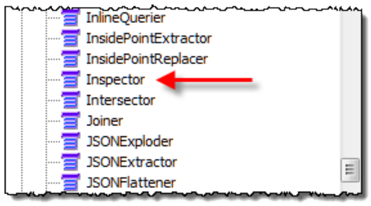


Here data is being directed away to the *Inspector* after the *Aggregator*, but before the *AreaCalculator*.

Note: An *Inspector* transformer can even be connected directly to a source Feature Type, in order to view the data immediately after it has been read by FME.

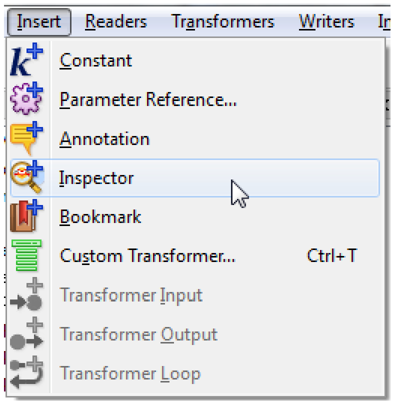
Placing an Inspector Transformer

There are a number of ways to place an *Inspector* transformer.



From the Transformer Gallery

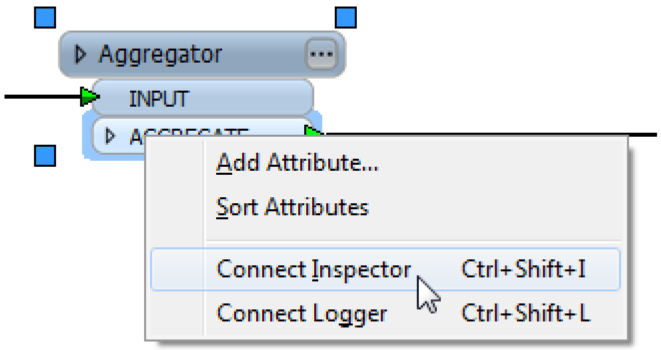
The *Inspector* – like any other transformer – appears in the Transformer Gallery and can be placed and connected in a workspace in the same way.



From the Menu bar

An *Inspector* can also be placed using **Insert** > **Inspector** on the Workbench menu bar.

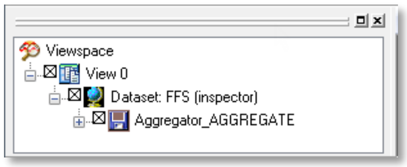
On the Canvas
Probably the best way to apply an *Inspector* – and the simplest – is to right-click the output port of an object in Workbench and select the **Connect Inspector** option.



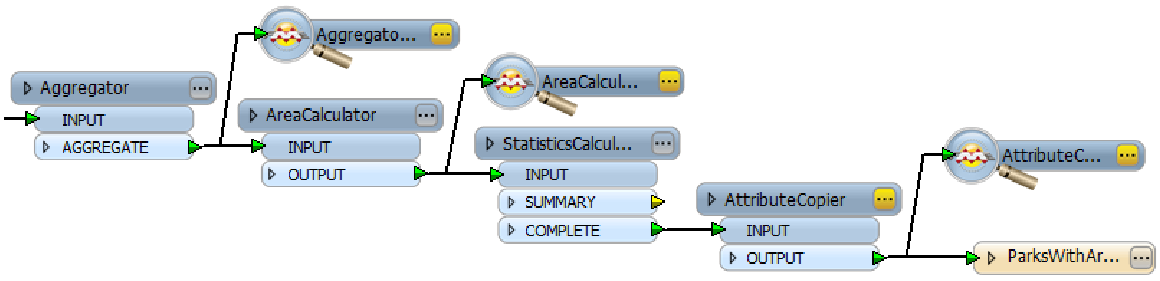
Copying the previous example, the user wants to output data from the *Aggregator* to FME Data Inspector.

The user right-clicks where it says "AGGREGATE" and chooses the option **Connect Inspector**.

Notice how an *Inspector* is named automatically using the transformer and output port names. This is a big advantage of using this method.

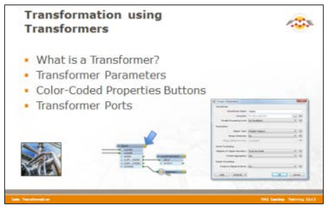


Notice that in the FME Data Inspector > Display Control window, the feature type is named the same as the *Inspector* within the workspace. This helps the user to identify data when multiple Inspectors are applied.



Functionality: Note that the Inspector transformer only opens the FME Data Inspector when there are features to view. If there are zero features, then the Inspector will not open!

Transformation Using Transformers


Transformation using Transformers

- What is a Transformer?
- Transformer Parameters
- Color-Coded Properties Buttons
- Transformer Ports

Besides Schema Editing and Schema Mapping, transformation can be carried out using objects called Transformers.

What is a Transformer?

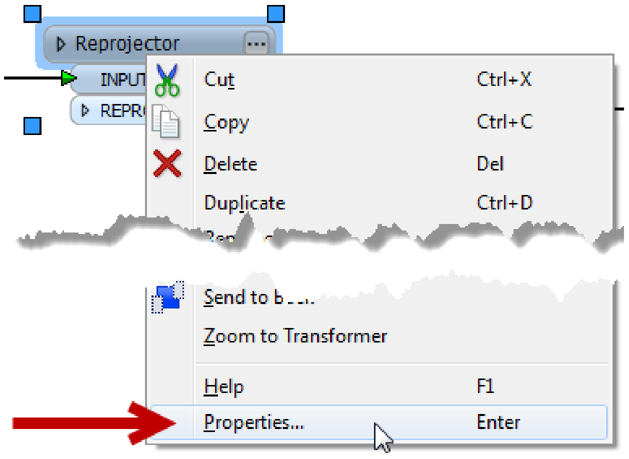
As the name suggests, a transformer is an FME Workbench object that carries out transformation of features. A number of different transformers exist to carry out different operations.

Transformers usually appear in the canvas window as rectangular, light-blue objects, although there are some transformers that vary from the norm with special shapes and colors.

Transformers are connected somewhere between the source and destination feature types, so that data flows from the reader feature types, through a transformation process, and on to the writer.

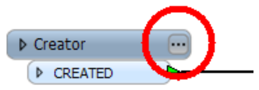
Transformer Parameters

Each transformer may have a number of parameters – also known as settings. Access the settings by either clicking the Properties button at the top right of each transformer or by right-clicking a transformer and selecting the Properties option. Both options are shown here.

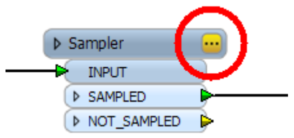


Color-Coded Properties Buttons

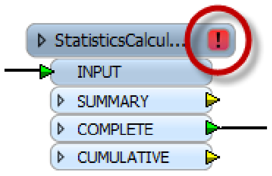
The Properties button on a transformer is color-coded to reflect the status of the settings, described ***below***.



A **blue** Properties button indicates that the default transformer settings have been checked and amended as required, and that the transformer is ready to use.

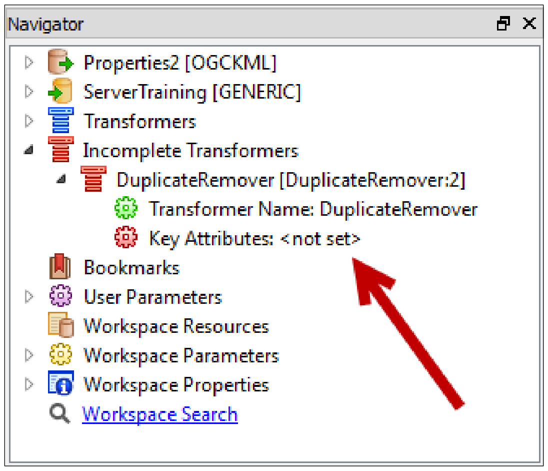


A **yellow** Properties button indicates that the default settings have not yet been checked. The transformer can be used in this state, but the results may be unpredictable.



A **red** Properties button indicates that there is at least one setting for which FME cannot supply a default value. The setting must be provided with a value before the transformer can be used.

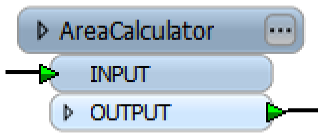
Incomplete transformers (those with a red Properties button) are also highlighted in red on the Navigator.



First-Officer Transformer says…

'When you have a red-flagged transformer, your translation just won't fly. You need to fix the settings before you can get off the ground.'

Transformer Colors
Transformers are all color-coded.

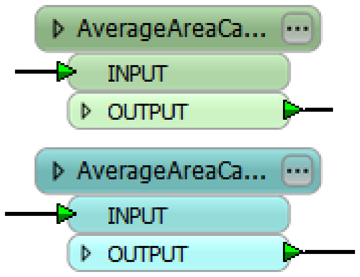


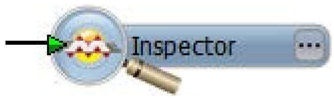
All regular transformers are colored blue like this *AreaCalculator* transformer.

Custom transformers have two different states: embedded or linked.

Embedded custom transformers are colored green whereas linked custom transformers are colored cyan.

Don't worry if you don't know what a custom transformer is yet; they're covered later.

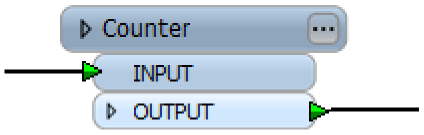


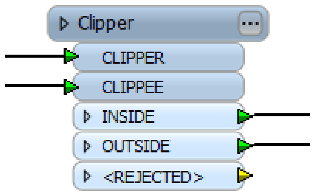


Some transformers, such as the *Inspector*, have their own distinctive icon.

Transformer Ports
Far from having just a single input and/or output, a transformer can have multiple input ports, multiple output ports, or both.

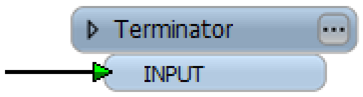
This *Counter* transformer has a single input and output port.

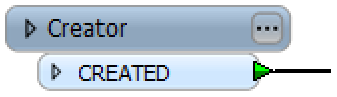




This *Clipper* has multiple input and output ports. Notice too that not all of them are – or need to be – connected.

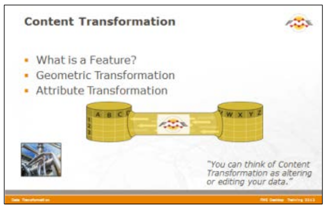
This *Terminator* has just a single input port...





…whereas this *Creator* has only a single output port!

Content Transformation



Content Transformation

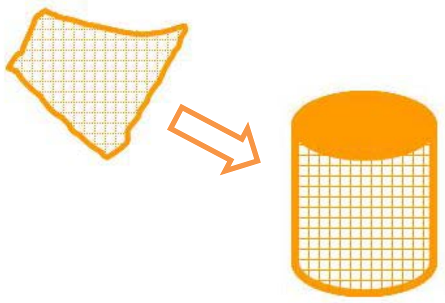
- What is a Feature?
- Geometric Transformation
- Attribute Transformation

"You can think of Content Transformation as altering or editing your data."

Content transformations are those that operate on the geometry or attribute content of a dataset.

What is a Feature?
A feature in FME is an individual item within the translation.

Typically a GIS or cartographic feature consists of a geometric representation plus a set of related attributes. FME is capable of restructuring either of these components.



A feature in FME is the fundamental (that is, smallest) unit of FME data.

Features in FME have a flexible, generic representation; in other words they have a basic FME definition that is unrelated to the format from which they originated.

Sometimes content transformation operates on single features, sometimes on multiple features at once.

Ms. Analyst says…

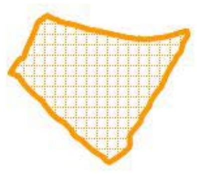
"You can think of Content Transformation as altering or editing data.

The wardrobe analogy still works here. You might take your clothes from the wardrobe to clean them, or alter them, or repair them, or dye them a new color, or all sorts of other tasks, before returning them to their place.

The same holds true for spatial data transformation: it's the act of fixing up your data to be cleaner and in the style you really want"

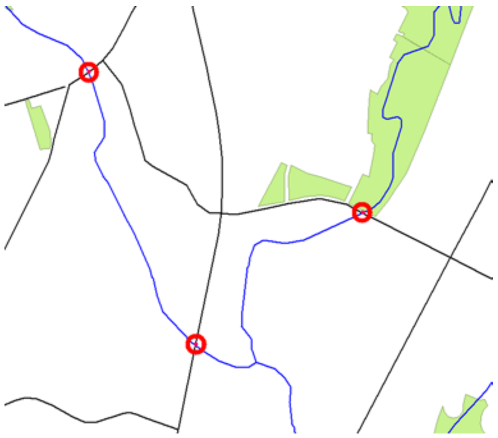
Geometric Transformation

Geometric Transformation is the act of restructuring the spatial component of an FME feature. In other words, the physical geometry of the feature undergoes some form of change to produce a different output.



Some examples of geometric transformation include the following:

- *Generalization* – a cartographic process that restructures data so it's easily visualized at a given map scale.
- *Warping* – adjustment of the size and shape of a set of features to more closely match a set of reference data.
- *Topology Computation* – conversion of a set of linear features into a node/line structure.



Line Intersection is another example of geometric transformation.

Here roads have been intersected with rivers to produce points that mark the location of bridges.

Attribute Transformation

Attribute Transformation is the act of restructuring the non-spatial component of an FME feature. In other words, the attributes relating to the physical geometry undergo some form of change to produce a different output.

Some examples of attribute transformation are:

- *Concatenation* – joining together of two or more attributes
- *Splitting* – splitting one attribute into many, which is the opposite of Concatenation
- *Measurement* – measuring a feature's length or area to create a new attribute
- *ID Creation* – creating a unique ID number for a particular feature

Attribute concatenation as an example of attribute transformation.
Each line of the address is concatenated to return a single line address.

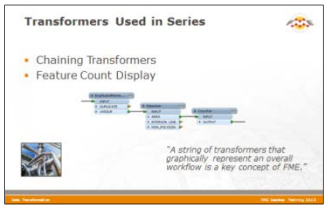
	Address1	***Suite 2017,***
+	Address2	***7445-132nd Street,***
+	City	***Surrey,***
+	Province	***British Columbia,***
+	PostalCode	***V3W 1J8***
=	Address	***Suite 2017, 7445-132nd Street, Surrey, British Columbia, V3W 1J8***

The most common FME translation is from Esri Shape to…… Esri Shape.
In other words, users are using FME for the transformation instead of the translation capabilities!

Mr. CAD says…

'Did you know, the most common FME translation is from Esri Shape to…… Esri Shape. In other words, users are using FME for the transformation instead of the translation capabilities!

Transformers used in Series



Transformers Used in Series

- Chaining Transformers
- Feature Count Display

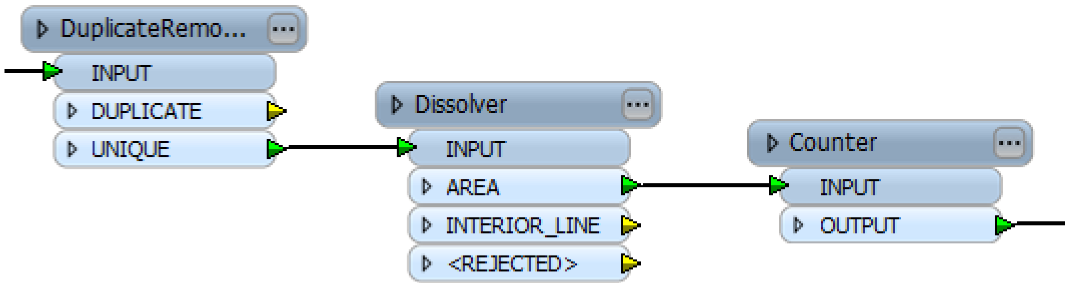
"A string of transformers that graphically represent an overall workflow is a key concept of FME."

Much like a set of components in an electrical circuit, a series of Workbench Transformers can be connected together to have a cumulative effect on a set of data.

Chaining Transformers
Despite the large number of transformers available in FME, users frequently find that a single transformer does not meet their requirements. In this situation, a combination or chain of transformers must be used.

A string of transformers that graphically represent an overall workflow is a key concept of FME.

In this example a *DuplicateRemover* transformer removes duplicate polygon features. A *Dissolver* transformer merges each remaining (unique) polygon with its neighbor where there is a common boundary. Finally each merged area gains an ID number from the *Counter* transformer.



Example 4: Content Transformation with Transformers	
Scenario	FME user; City of Interopolis, Planning Department
Data	CSV format dataset of Cell Phone towers
Overall Goal	Create spatial data and extract information for use in Data Analytics
Demonstrates	Use of transformers in series
Starting Workspace	C:\FMEData\Workspaces\DAManual\Example4Begin.fmw
Finished Workspace	C:\FMEData\Workspaces\DAManual\Example4Complete.fmw

The data we are working with is now a series of point features with various attribute values that can be used for analytics. However, a typical requirement when handling sets of point features is to aggregate them spatially, into districts, in order to summarize statistics for that district.

In this case there's no existing geographical boundaries we can group against (the county boundaries we looked at earlier don't have an even enough distribution of points) so we'll create our own grid.

1) Start Workbench

Start Workbench (if necessary) and open the workspace from Example 2.
Alternatively you can open *C:\FMEData\Workspaces\DAManual\Example4Begin.fmw*

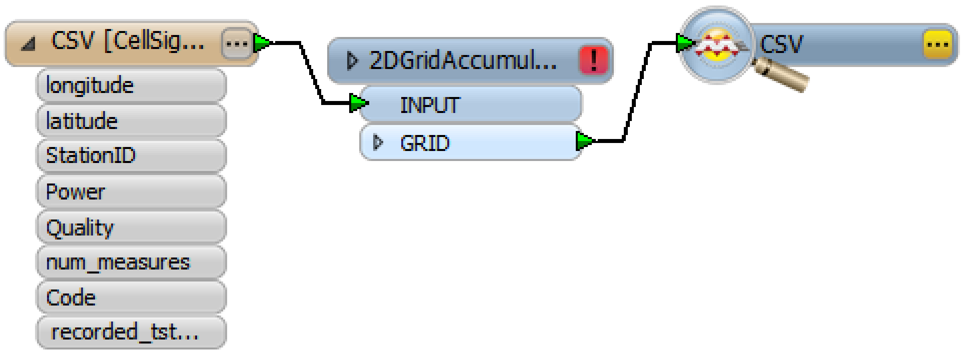
Delete any existing Inspector transformers, as we'll be modifying the output now.

2) Place a 2DGridAccumulator

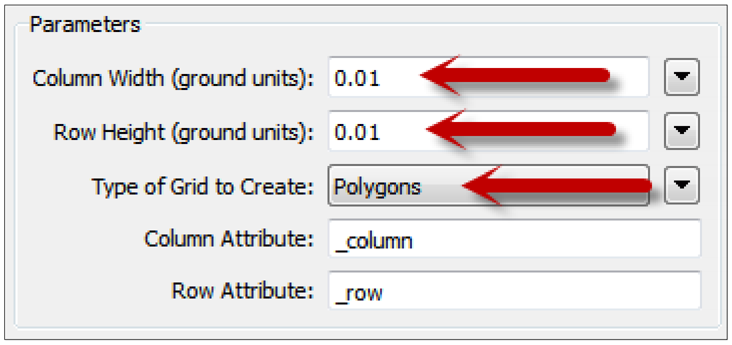
Place a 2DGridAccumulator transformer in the workspace. Remember, you can do this by clicking on a blank spot on the Canvas, and typing: 2DGrid…

Once the 2DGridAccumulator is added to the Canvas, click-and-drag it towards the Reader feature type.

A little pink dot will appear on the upper-left corner of the transformer when you move it. Place that pink dot over the feature type output port (or the following connector) and release the mouse button.



3) Set 2DGridAccumulator Parameters
Open the parameters dialog for the 2DGridAccumulator by clicking the red [!] button.



Parameters

Column Width (ground units): 0.01

Row Height (ground units): 0.01

Type of Grid to Create: Polygons

Column Attribute: _column

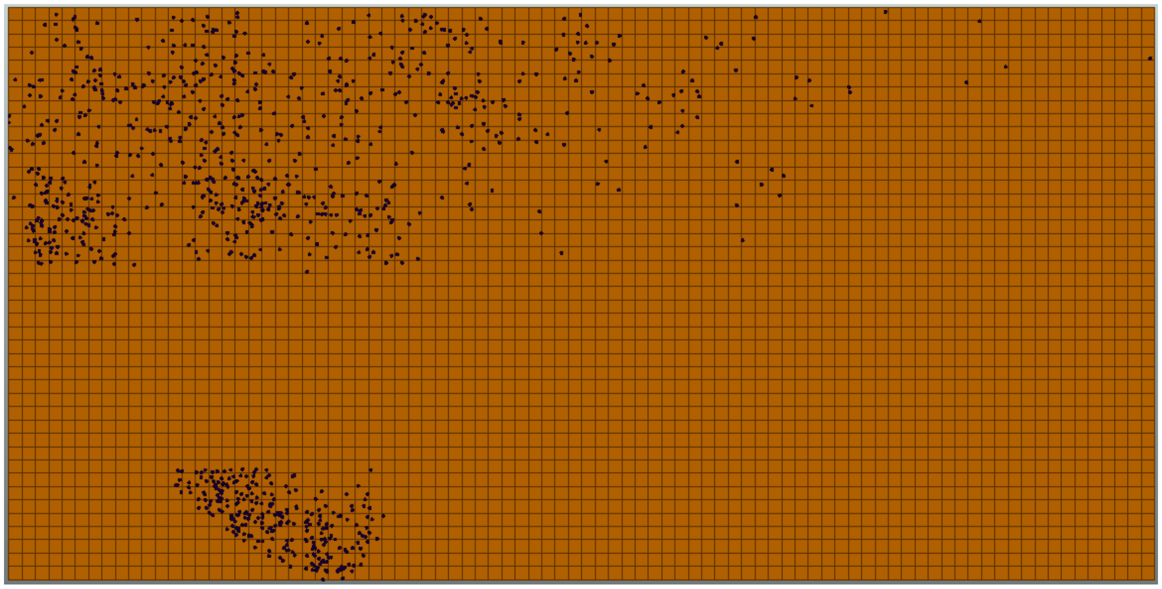
Row Attribute: _row

Set the parameters to create polygons with a column width and row height of 0.01 (remember we are using decimal degrees here).

Make sure the grid type parameter is set to Polygons (not Points).

Click **OK** to accept the parameters.

4) Run Workspace
Connect Inspector transformers to the Reader feature type and 2DGridAccumulator output ports (if one is not already connected) and run the workspace. Can you see what the result of this is? We now have a grid of features that can be used to group/aggregate information for the cell towers.



It's a common technique in FME – especially when you are new to the product – to place one or two transformers and then run the workspace; just to make sure they are doing what you expect. It's much easier to 'debug' any problems when you work this way, rather than creating an entire workspace and then realizing that something is not working as expected.

Transformer Handling

It's important to know all the ways to locate, place, and connect transformers.

At this point it's worth reviewing the different ways of handling transformers within Workbench.

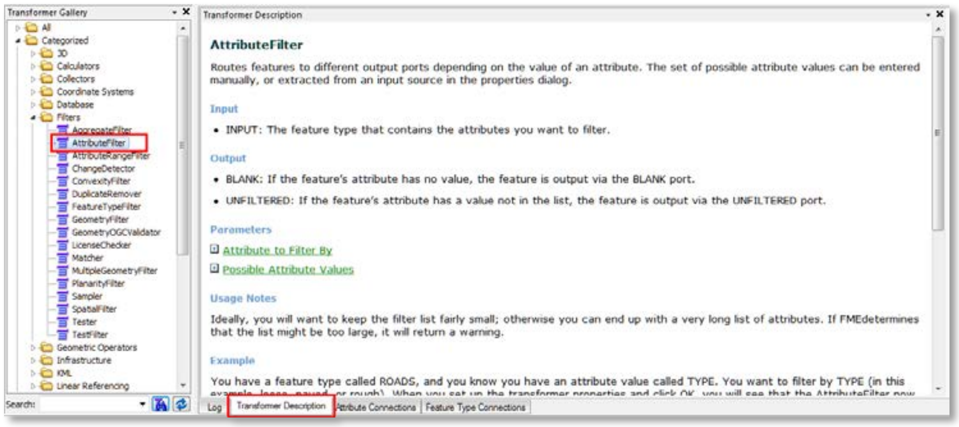
Transformer Gallery
The transformer gallery is a window through which to locate and place transformers.
Along with the Transformer Description window it plays a key part in basic transformer placement.

The Transformer Gallery is divided into different sections and categories to help users find transformers. Expanding the Categorized folder displays the various categories. Expanding the *All* folder displays FME's full list of transformers (400+).

Another way to locate a transformer in the gallery is to type a keyword into the search field.

The transformer description window provides help for the currently selected transformer. It also provides a link to articles and examples on FMEpedia.

Here the Filters category of transformers is open and the *AttributeFilter* transformer is selected.



AttributeFilter

Routes features to different output ports depending on the value of an attribute. The set of possible attribute values can be entered manually, or extracted from an input source in the properties dialog.

Input

- INPUT: The feature type that contains the attributes you want to filter.

Output

- BLANK: If the feature's attribute has no value, the feature is output via the BLANK port.
- UNFILTERED: If the feature's attribute has a value not in the list, the feature is output via the UNFILTERED port.

Parameters

Attribute to Filter By
Possible Attribute Values

Usage Notes

Ideally, you will want to keep the filter list fairly small; otherwise you can end up with a very long list of attributes. If FMEdetermines that the list might be too large, it will return a warning.

Example

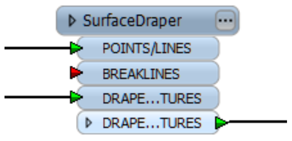
You have a feature type called ROADS, and you know you have an attribute value called TYPE. You want to filter by TYPE (in this

How to use the Transformer Gallery
After a transformer is located in the gallery, it can be double-clicked it to place it on the canvas.

Alternatively, it can be placed by dragging and dropping it onto the workspace canvas. Many users drag and drop transformers because that gives them greater control over where the transformer is positioned initially.

When placed, users can add transformers into a workflow by dragging connections onto the transformer's input ports and dragging connections from the transformer's output ports.

Here a *SurfaceDraper* transformer has been placed and connected.

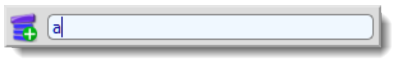


Quick Add

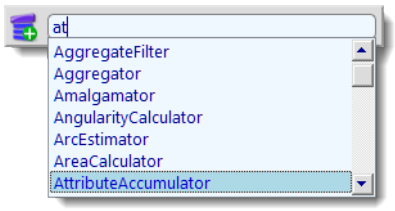
Quick Add is a way to search for and add transformers to the workspace. This makes it easily more convenient than the Transformer Gallery for most uses.

How to Use Quick Add

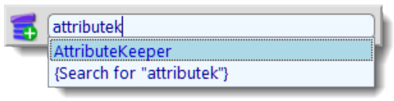
Quick Add is a dialog on the workspace canvas that is used to search for a transformer by name. To use it, click an area of blank space on the workspace canvas and type a letter on the keyboard; for example, **a**. At this point a small dialog opens that looks like this.


a

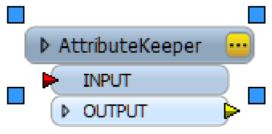
Continue to type (for example the letter **t**), and a list of transformers with names that match the typed content starts to appear.


at
AggregateFilter
Aggregator
Amalgamator
AngularityCalculator
ArcEstimator
AreaCalculator
AttributeAccumulator

The more letters typed, the smaller the list gets until the required transformer can be located.

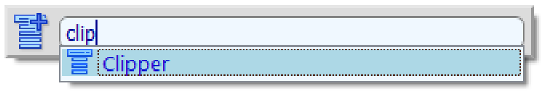

attributek
AttributeKeeper
{Search for "attributek"}

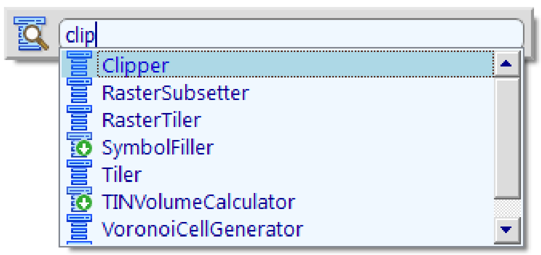
Pressing Enter (the return key) or clicking the transformer name causes it to be placed on the workspace canvas. Notice that it is pre-selected, so that pressing the return key again will now open the parameters dialog for the transformer.



Sister Intuitive says…

"Quick Add is one of my favorite things about FME. And notice that if you press the Tab key in Quick Add mode, you switch from a transformer name search to a transformer description search. That's truly heavenly!"


clip
Clipper

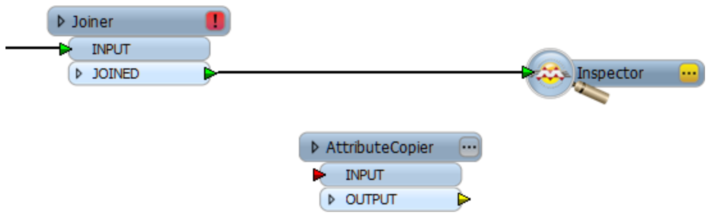

clip
Clipper
RasterSubsetter
RasterTiler
SymbolFiller
Tiler
TINVolumeCalculator
VoronoiCellGenerator

Drag-and-Insert

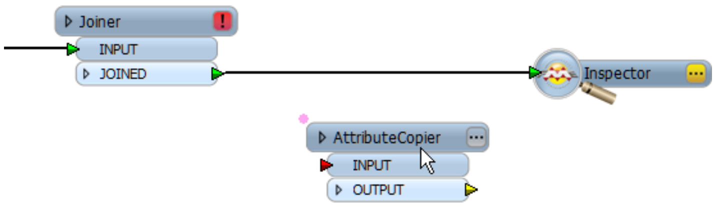
Doctor Workbench says…

"If you see pink spots, don't worry! It's not a disease… it's the FME drag-and-insert functionality for speedier transformer placement!"

Here a user wants to insert this *AttributeCopier* transformer into the pipeline.

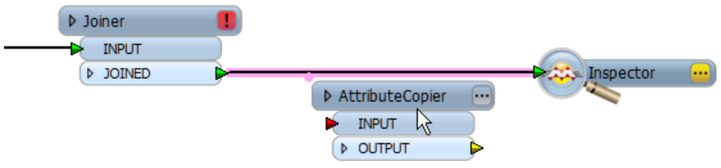


This functionality is activated automatically when a transformer is dragged across the canvas and shows as a small pink colored spot on the transformer's left-hand side.



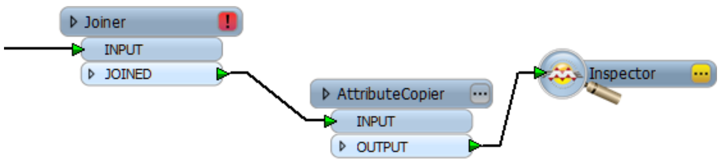
Now the user starts to drag the transformer and the pink spot appears.

Drag the transformer until the pink spot covers an existing connection. That connection becomes highlighted to indicate it is where the transformer is to be inserted.



Now the user drags the pink spot over the existing connection, which becomes highlighted.

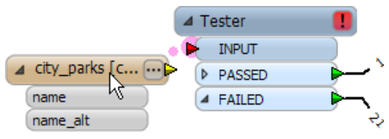
Release the transformer to drop it into position and connect it automatically.



The user releases the transformer and it is inserted into the pipeline.

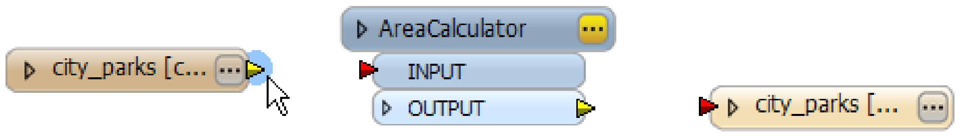
Don't forget drag-and-insert (or even drag-connect) works on any workspace object, including feature types.

With this ability a feature type can be attached onto a transformer instead of the other way around

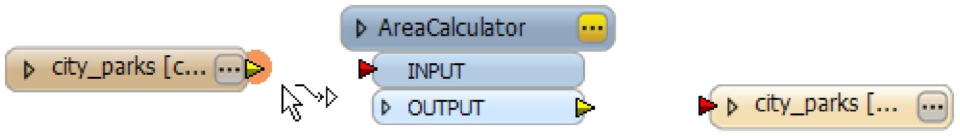


Quick Connect
Quick Connect is a way of making connections between transformers and feature types that does not involve dragging links between the two. All the user needs to do is click the appropriate input and output ports, and a connection is made.

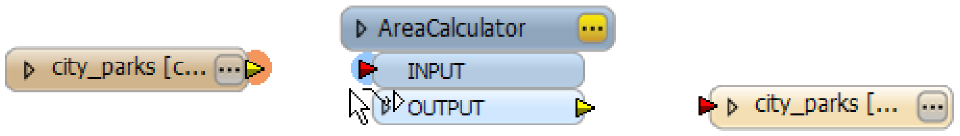
Hover over an output port and it is highlighted in blue.



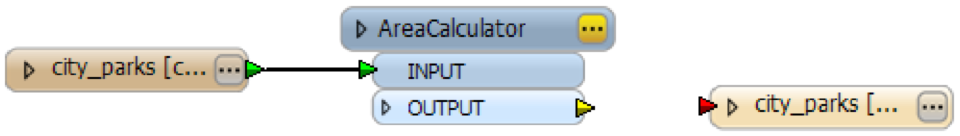
Select the port and it is highlighted orange. The cursor also changes shape.



Hover over an input port and it now highlights blue.



Select the port and the connection is complete.



When to use Quick Connect
Quick Connect is the best method to use when connecting two objects at far ends of a large workspace. Without Quick Connect the user would need to zoom out to a level at which both objects could be seen. This makes it difficult to create the connection.

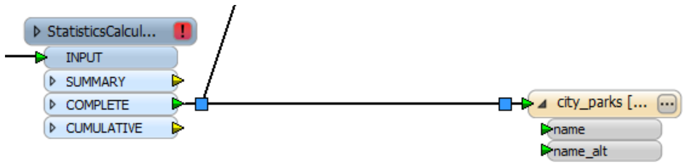
With Quick Connect the two objects do not need to be on screen simultaneously. A user can click on the first port (at any zoom level) and use window panning tools to move to the next port.

Combining Quick Add, Drag-Insert and Quick Connect

Perhaps the best thing about these transformer shortcuts is that they are all fully integrated, so that Quick Add can be used in combination with either of the Drag-and-Insert and Quick Connect methods of placing transformers.

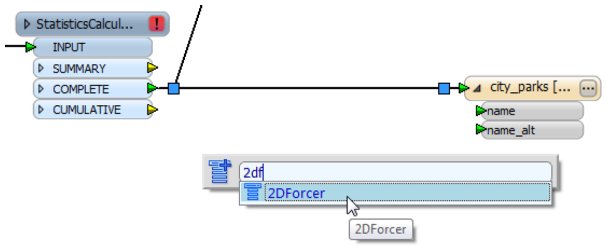
This integration operates in a number of ways.

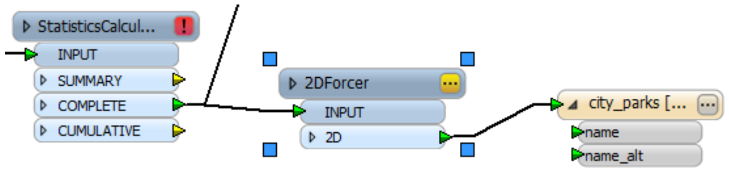
If a connection is selected on the canvas already, when a transformer is placed using Quick Add the transformer is inserted automatically into that connection.



For example, the user first selects an existing link.

Now they select a transformer with Quick Add.

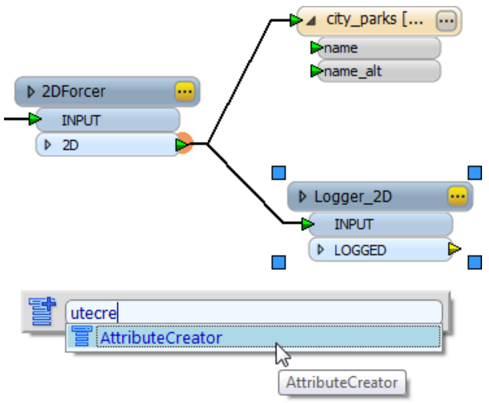


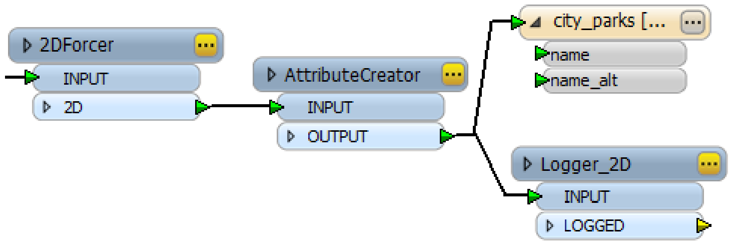


Then the new transformer is inserted directly into the chosen connection.

If a port is already selected on the canvas, the new transformer is inserted automatically or attached onto all connections on that port.

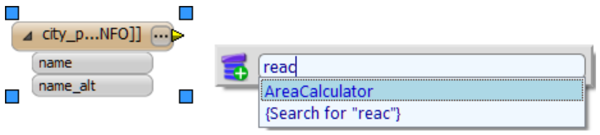
Here the user has selected an existing port:





Quick Add adds the new transformer into both links emerging from the chosen port.

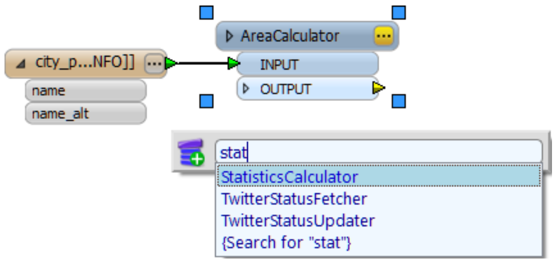
If a transformer or source Feature Type is already selected on the canvas, then the new transformer is connected automatically after the existing transformer.

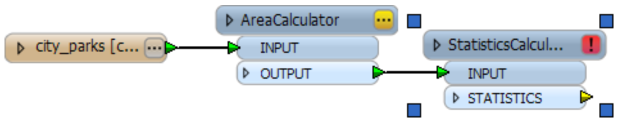


Using Quick Add a source Feature Type is selected while a transformer is added.

The new transformer is placed and connected to the selected Feature Type.

Because the new transformer is pre-selected automatically, the user can now continue adding transformers.



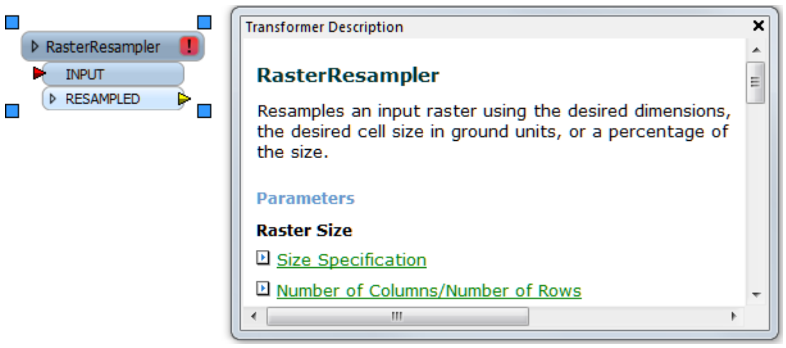


The second transformer is added after the first, and so on.

Transformer Description Window
As mentioned, it's possible now to keep the Transformer Gallery closed for most of the time, and to use Quick Add functionality instead. What really makes this feasible is that the Transformer Description is split off as a separate window.

Then the Transformer Gallery may be closed and the Transformer Description window retained.

Additionally, the Transformer Description window shows HTML-based help for whatever transformer is selected on the workspace canvas.



RasterResampler

Resamples an input raster using the desired dimensions, the desired cell size in ground units, or a percentage of the size.

Parameters

Raster Size

Size Specification

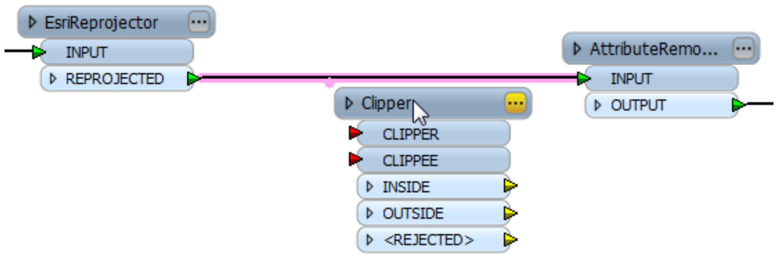
Number of Columns/Number of Rows

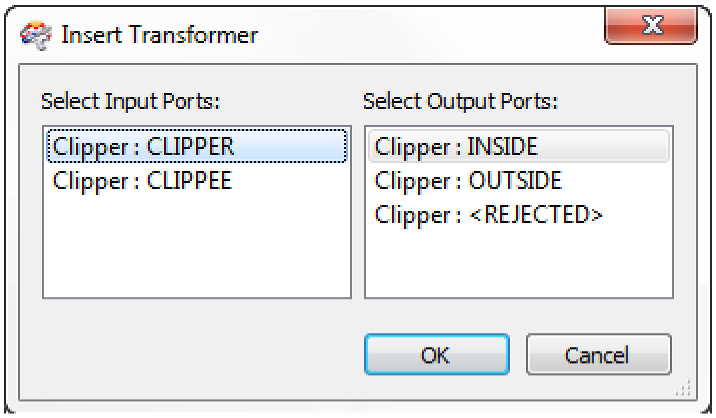
Inserting Multi-Port Transformers
When a transformer has only a single input and output port, FME is able to determine immediately the drag-n-insert connections to make.

However, many transformers possess more than a single input or output port and, therefore, an automatic connection cannot be made. In these cases, the user is prompted to define what connections are required through a dialog.

Here the transformer to be inserted is a *Clipper*.

The *Clipper* has two input ports and three output ports.




Insert Transformer

Select Input Ports:

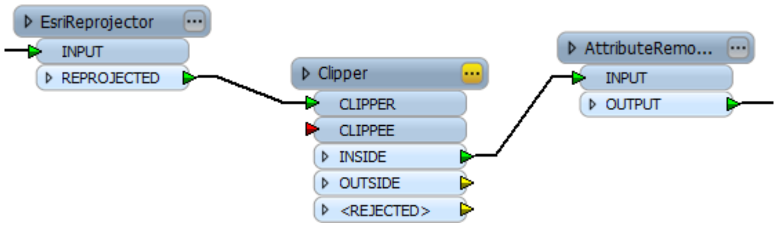
Clipper : CLIPPER
Clipper : CLIPPEE

Select Output Ports:

Clipper : INSIDE
Clipper : OUTSIDE
Clipper : <REJECTED>

When the *Clipper* is dropped into position, FME opens a dialog and prompts the user to select which input and output ports are to be connected.

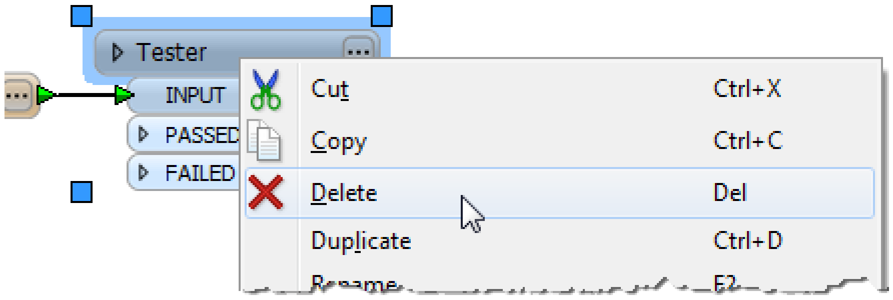
When the user clicks OK, Workbench makes the connection as defined by the selected ports.



Transformer Deletions

FME doesn't only provide tools for adding transformers efficiently; it also has powerful tools for removing them too.

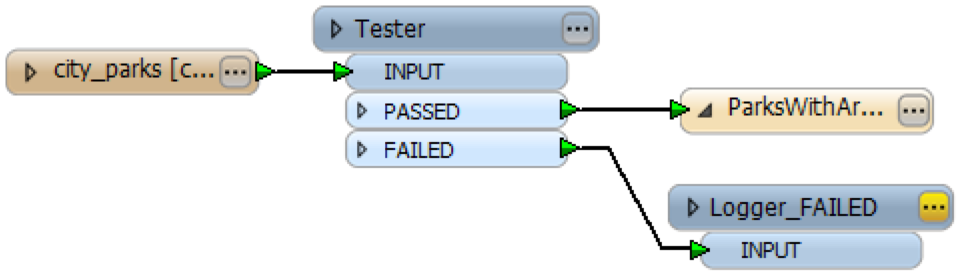
Transformers can be deleted either by selecting the transformer and pressing the <delete> key, or by right-clicking the transformer and choosing Delete.



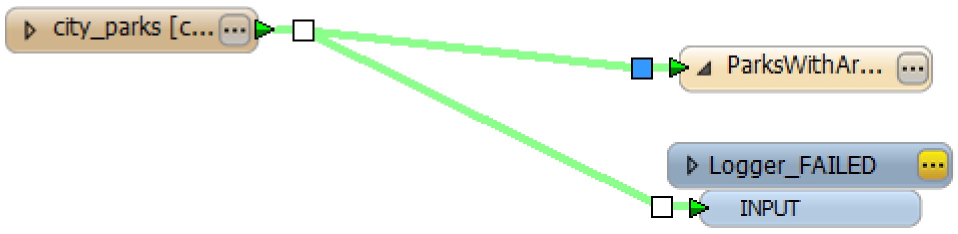
Smart Delete

When a transformer is removed, FME doesn't just leave a gap, but instead tries to reconnect the surrounding objects. This technology is called Smart Delete. When objects are automatically reconnected in this way, the connections are colored green so the user is aware of what has happened. They are also automatically selected. Therefore the user can just press <delete> for a second time to remove them.

Here a user wishes to remove the Tester transformer:

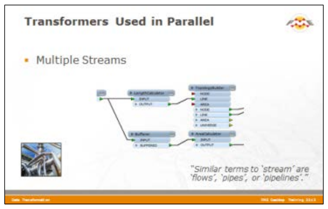


They select the Tester, press the delete key and Smart Delete removes the transformer and reconnects the surrounding objects. If the user does not require the new connections they can simply press the delete key again.



To bypass the Smart Delete function, press the <shift> key while deleting an object.

Transformers used in Parallel


Transformers Used in Parallel

- Multiple Streams

"Similar terms to 'stream' are 'flows', 'pipes', or 'pipelines'."

FME Workbench permits multiple data streams, each of which passes through its own set of transformers.

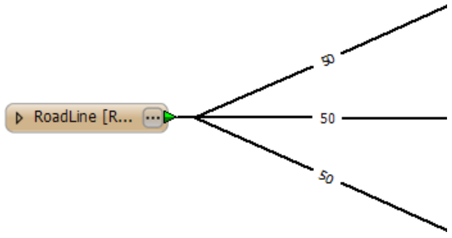
Multiple Streams
A key concept in FME is the ability to create multiple processing streams within a workflow or to bring several streams together into one.

Similar terms to 'stream' are 'flows', 'pipes', or 'pipelines'.

Creating Multiple Streams
Splitting data occurs with any transformer with multiple output ports (example 2 is a good illustration of this point) but can also be achieved by simply making multiple connections out of a single output port.

When using multiple ports the data is being split amongst the different streams.

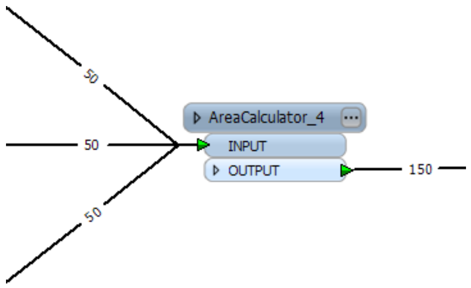
However, when using multiple connections from a single port, the data is being duplicated rather than being split. In effect it creates a set of data for each connection.



Here 50 road features are being read but, because there are multiple connections from the feature type, multiple copies of the data are being created.

Multiple streams are useful when a user needs to process the same data, but in a number of different ways.

Bringing Together Multiple Streams
When multiple streams are brought into the same input port no merging takes place. The data is simply accumulated into a single stream.



Here three streams of 50 features each, converge upon a single AreaCalculator:INPUT port.

Notice how no merging has taken place; the data simply accumulates into 150 output features.

To carry out actual merging of data requires a specific transformer such as the *FeatureMerger*.

Example 5: Content Transformation with Parallel Transformers	
Scenario	FME user; City of Interopolis, Planning Department
Data	CSV format dataset of Cell Phone towers
Overall Goal	Create spatial data and extract information for use in Data Analytics
Demonstrates	Use of transformers in parallel
Starting Workspace	C:\FMEData\Workspaces\DAManual\Example5Begin.fmw
Finished Workspace	C:\FMEData\Workspaces\DAManual\Example5Complete.fmw

The previous example created a grid by which point feature data could be aggregated into areas. The next task is to transfer all of the information from the points onto their related grid square.

1) Start Workbench
Start Workbench (if necessary) and open the workspace from Example 4.
Alternatively you can open *C:\FMEData\Workspaces\DAManual\Example5Begin.fmw*

Delete any existing Inspector transformers, as we'll be modifying the output now.

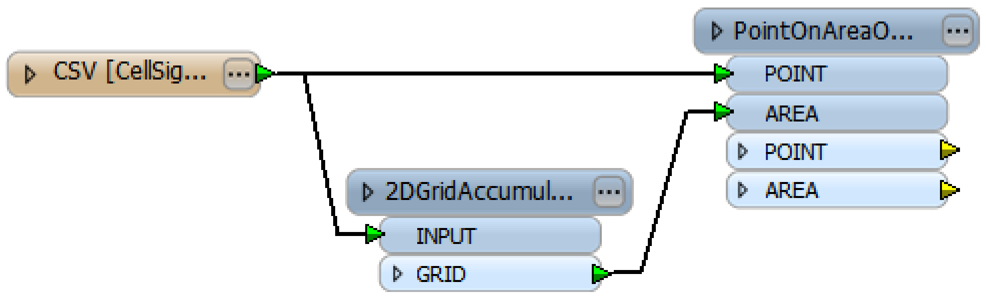
2) Place a PointOnAreaOverlayer
Add a PointOnAreaOverlayer transformer. This transformer carries out a spatial analysis and copies attribute data from points onto their surrounding areas.

The difference this time is that we'll connect this transformer in parallel to an existing stream.

Connect the output port of the Reader feature type to the POINT input port of the PointOnAreaOverlayer.

Connect the GRID output port of the 2DGridAccumulator to the AREA input port of the PointOnAreaOverlayer.

3) Set Parameters
Open the PointOnAreaOverlayer parameters dialog. Enter a list name of *mylist*.
Click **OK** to accept the changes.



Terminology: *A List in FME is a mechanism that allows multiple values per attribute.*

For example, the attribute myAttribute can only contain a single value.
However, the list attribute myList{}.myAttribute can contain multiple values as:

myList{0}.myAttribute
myList{1}.myAttribute
myList{2}.myAttribute
etc.

4) Run Translation

Connect Inspector transformers where you think necessary to inspect the output of this step. Run the workspace and inspect the grid features to see what the result of this action is.

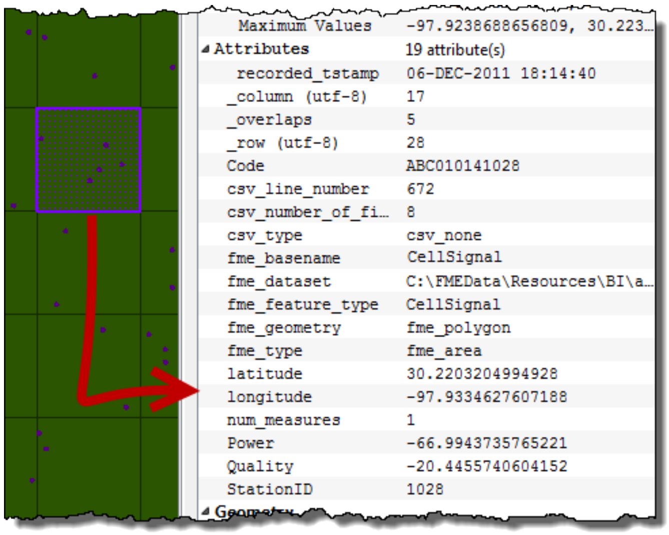
5) Remove Unwanted Attributes

FME translations perform faster, and produce cleaner results, when you can remove any unrequired data.

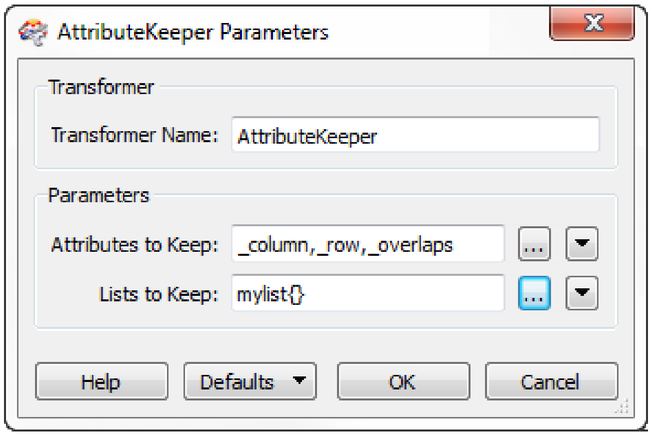
In this case, the output area features have a lot of attributes. We'll remove the ones we don't need and keep only _column, _row, _overlaps, and list{}.

You can clean up attributes with either an AttributeRemover or AttributeKeeper transformer.

In this case we'll use the AttributeKeeper as there are fewer attributes that we want to keep than we want to remove, and this transformer will be easier to use.



Maximum Values	-97.9238688656809, 30.223…
Attributes	19 attribute(s)
recorded_tstamp	06-DEC-2011 18:14:40
_column (utf-8)	17
_overlaps	5
_row (utf-8)	28
Code	ABC010141028
csv_line_number	672
csv_number_of_fi…	8
csv_type	csv_none
fme_basename	CellSignal
fme_dataset	C:\FMEData\Resources\BI\a…
fme_feature_type	CellSignal
fme_geometry	fme_polygon
fme_type	fme_area
latitude	30.2203204994928
longitude	-97.9334627607188
num_measures	1
Power	-66.9943735765221
Quality	-20.4455740604152
StationID	1028
Geometry	



AttributeKeeper Parameters

Transformer

Transformer Name: AttributeKeeper

Parameters

Attributes to Keep: _column,_row,_overlaps

Lists to Keep: mylist{}

Place an AttributeKeeper transformer and connect it to the AREA output port of the PointOnAreaOverlayer.

Open the AttributeKeeper parameters dialog.

Select _column, _overlaps, and _row as the attributes to keep.

Select mylist{} as the list to keep.

6) Remove unwanted features

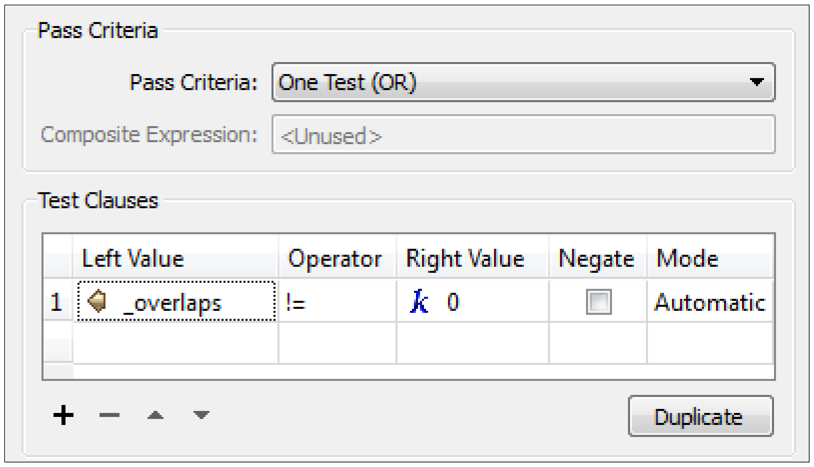
Another way to improve performance and results is to remove unrequired features.
In this example we can remove any grids that did not have points within them.

This can be done with a Tester transformer.

Place a Tester transformer, connected to the OUTPUT output port of the AttributeKeeper.

Open the Tester parameters dialog. Notice that it is similar to the filtering dialog in the FME Data Inspector application.

Set up a single test clause to test where the value of the _overlaps attribute is not zero.



Pass Criteria

Pass Criteria: One Test (OR)

Composite Expression: <Unused>

Test Clauses

	Left Value	Operator	Right Value	Negate	Mode
1	_overlaps	!=	0	☐	Automatic

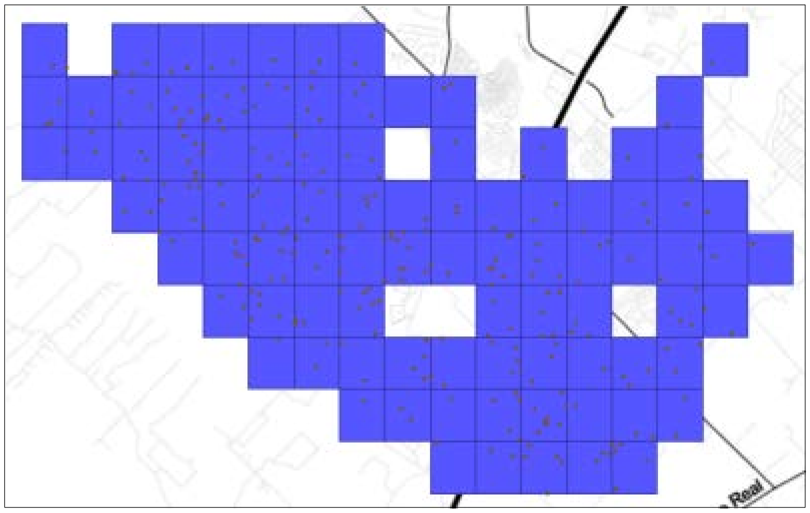
_overlaps represents the number of points that fell within the polygon.

Provided it is not zero then the polygon will pass the test and we will keep it.

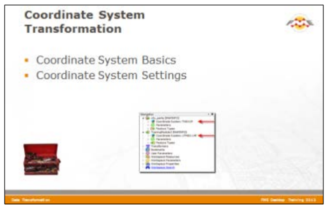
7) Save and Run Workspace

Connect Inspectors to the various transformers – you decide what exactly you want to inspect – and then save the workspace.

Now run the translation. You should find output that looks something like this section:



Coordinate System Transformation


Coordinate System Transformation

- Coordinate System Basics
- Coordinate System Settings

To be located in a particular space on the Earth's surface the majority of spatial data is related to a particular coordinate system.

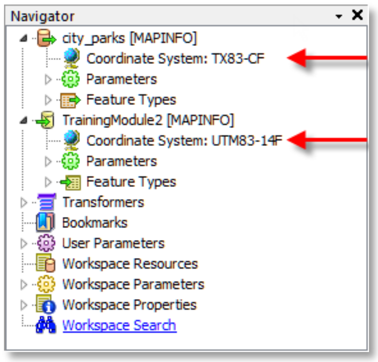
Coordinate System Basics

Each feature that is processed by FME is coordinate system aware; that is, it knows what coordinate system it belongs to at all times. This helps prevent confusion when reading multiple datasets that belong to different coordinate systems.

Terminology: *Some users call this location of data a 'projection', but projection is just one component of a definition within space. A true definition includes projection, datum, ellipsoid, units, and sometimes a quadrant, which together is called a 'Coordinate System'.*

Coordinate System Settings

Each source reader and destination writer within FME is assigned a coordinate system. That coordinate system is set in the navigation pane of Workbench.

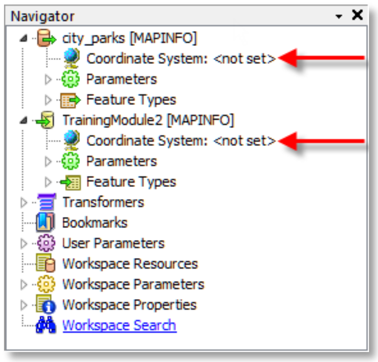

Navigator
city_parks [MAPINFO]
Coordinate System: TX83-CF
Parameters
Feature Types
TrainingModule2 [MAPINFO]
Coordinate System: UTM83-14F
Parameters
Feature Types
Transformers
Bookmarks
User Parameters
Workspace Resources
Workspace Parameters
Workspace Properties
Workspace Search

Here the source coordinate system has been defined as TX83-CF and the destination as UTM83-13F.

When a translation is carried out where the source and the destination coordinate systems differ in this way, FME automatically restructures the data, at the end of the translation, so that the output is in the correct location.

Automatic Detection of Coordinate Systems

Some data formats are capable of containing information about the coordinate system in which they are held. Shape format is one example of this. FME can be set to detect any such information.


Navigator
city_parks [MAPINFO]
Coordinate System: <not set>
Parameters
Feature Types
TrainingModule2 [MAPINFO]
Coordinate System: <not set>
Parameters
Feature Types
Transformers
Bookmarks
User Parameters
Workspace Resources
Workspace Parameters
Workspace Properties
Workspace Search

Because the source Reader coordinate system is marked <not set>, FME will try to determine the coordinate system from the source dataset.

Because the destination Writer coordinate system is marked <not set>, FME will not reproject the data. Instead FME writes the data using the same coordinate system as the source data.

Example 6: Basic Reprojection	
Scenario	FME user; City of Interopolis, Planning Department
Data	CSV format dataset of Cell Phone towers
Overall Goal	Create spatial data and extract information for use in Data Analytics
Demonstrates	Spatial Data Reprojection
Starting Workspace	C:\FMEData\Workspaces\DAManual\Example6Begin.fmw
Finished Workspace	C:\FMEData\Workspaces\DAManual\Example6Complete.fmw

Decimal degrees are not a very good method to define the size of the grid being created. A more natural measure would be either feet or metres. Let's reproject the data so we can do just that.

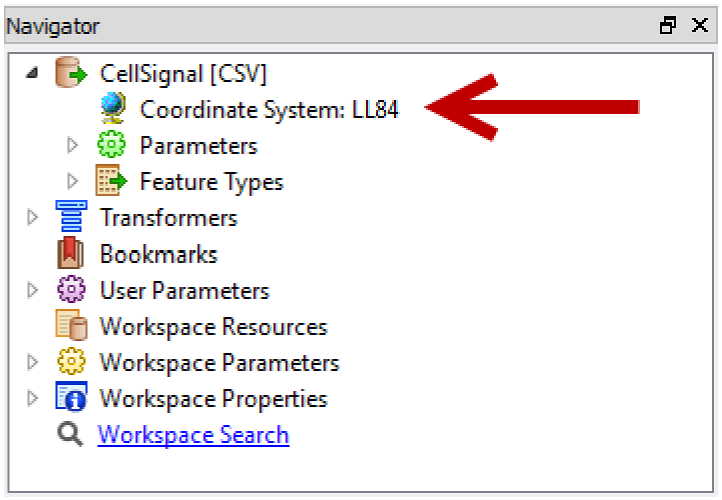
1) Start Workbench
Start Workbench (if necessary) and open the workspace from Example 5.
Alternatively you can open *C:\FMEData\Workspaces\DAManual\Example6Begin.fmw*

Delete any existing Inspector transformers, as we'll be modifying the output now.

2) Double-check Reader Coordinate System
On the Navigator locate the CSV reader, and expand its list of parameters.

Locate the parameter labelled 'Coordinate System'. The original value should be LL84.

If the value is not LL84, then double-click the parameter to open an editor dialog and enter the coordinate system name LL84 (or select it from the Coordinate System Gallery using the Browse button).



Remember, when a Reader's Coordinate System parameter is defined as "<not set>" FME will automatically try to determine the correct coordinate system from the dataset itself.

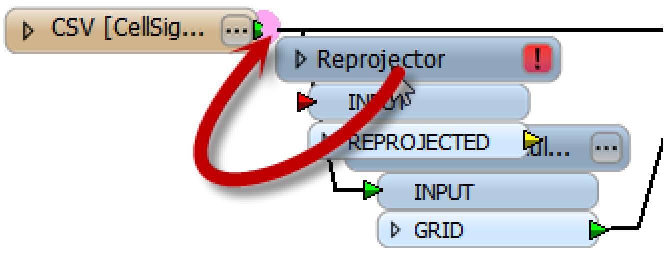
When the source dataset is in a format that does NOT store coordinate system information (as CSV format will not) then you MUST set this parameter when you wish to reproject data derived from this reader; otherwise FME will not know how to carry out the reprojection and an error will occur.

Incidentally, there is a one-to-one relationship between Reader and coordinate system; so each Reader feature type must be the same coordinate system. This is different to a Writer – which can be more granular – and where each feature type can have its own coordinate system!

3) Add a Reprojector Transformer
To have data reprojected mid-translation requires the use of a transformer; in this case we'll use the Reprojector transformer.

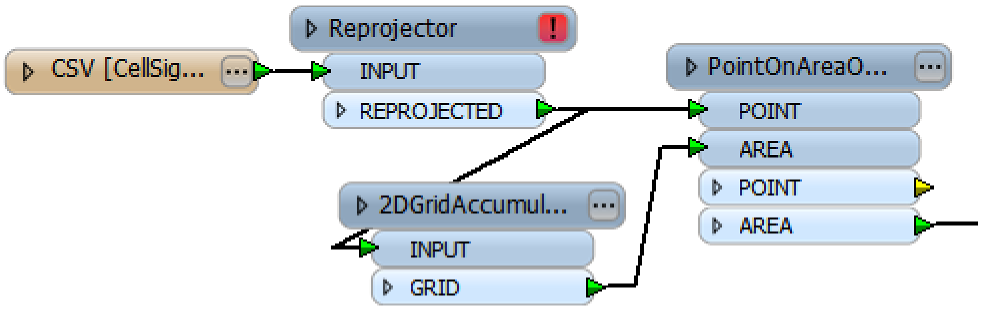
Add a Reprojector transformer onto the canvas. It will need to be connected after the Reader feature type, but to both the parallel outputs from that object. However, this can be easily done.

Drag the transformer until the pink dot lies over the green output port arrow on the 2DPointReplacer. Then release the mouse button:



Drag the Reprojector again into a clear space, and rearrange the other transformers around it.

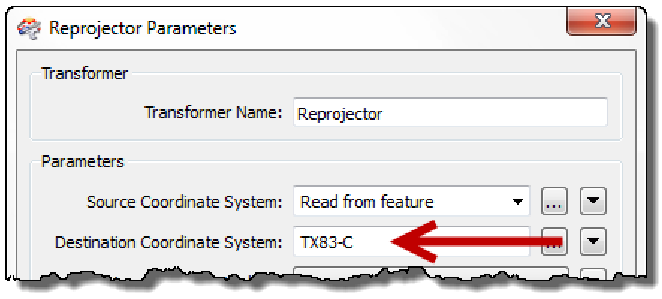
That section of the workspace will now look like this:



Open the Reprojector's parameters dialog.

The Source Coordinate System parameter can be left as *Read from feature*, as we already checked that the incoming data is properly tagged with its correct coordinate system

Set the Destination Coordinate System to TX83-C. Click **OK** to accept the changes.



Reprojector Parameters

Transformer

Transformer Name: Reprojector

Parameters

Source Coordinate System: Read from feature

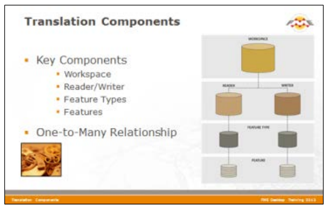
Destination Coordinate System: TX83-C

4) Update the 2DGridAccumulator
Open the parameters dialog for the 2DGridAccumulator.
Set the Column Width and Row Height to 1000 (metres) instead of 0.01 (decimal degrees).

Re-run the translation. If you still have the previous view still open in the FME Data Inspector, then switch between the views to see what changes have occurred (you may need to zoom in closely to tell what has changed).

Translation Components

Translation Components


Translation Components

- Key Components
  - Workspace
  - Reader/Writer
  - Feature Types
  - Features
- One-to-Many Relationship

An FME translation is made up of a number of different components.

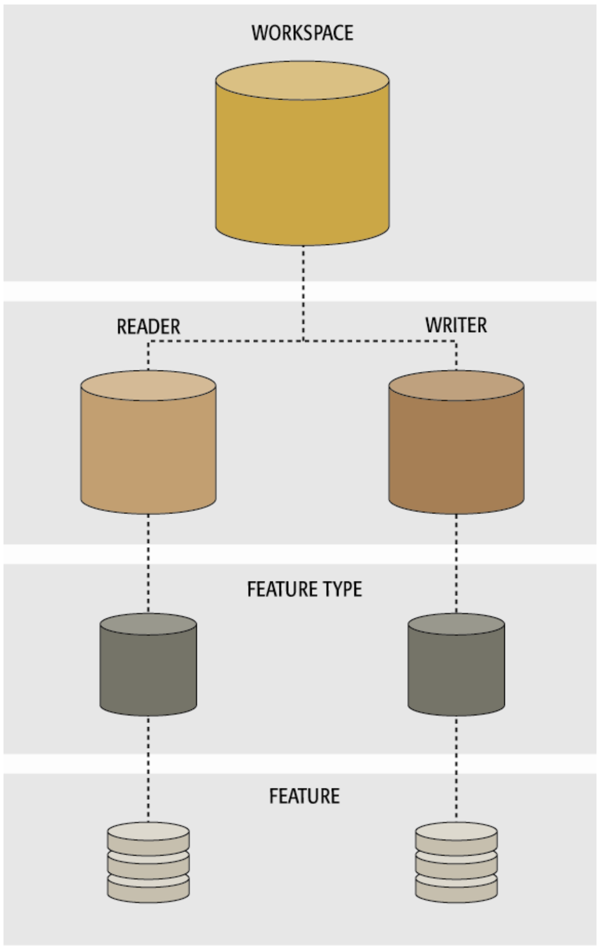
There are many different components that go to make up a translation.

For each component there are tools within FME to create, add, or remove them; and parameters in Workbench in order to control them.

In particular, each component has very specific terminology applied to it, and it's useful to have a full understanding of this terminology, especially when working with multiple datasets.

Key Components
The list of key components in an FME translation is as follows:

- Workspace
- Readers and Writers
- Feature Types
- Features



It's important to notice that all these components exist in a related hierarchy.

Hierarchy is an important concept because it affects how components are added to a translation, and – more importantly – parameters at one level of the hierarchy can affect components at a different level.

This section covers "official" FME components only.

For example, it won't cover any user-defined Python scripting that might be used to exert control over several workspaces.

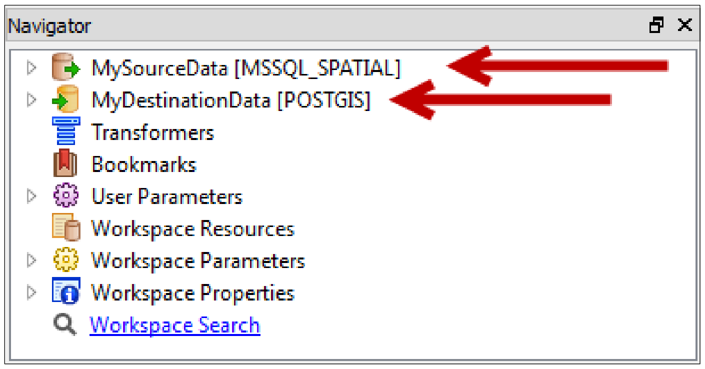
However, it's easy to look at this hierarchy diagram and imagine where such custom components might fit it.

Workspace
A workspace is the primary element in an FME translation and is responsible for storing a translation definition. A workspace is held as a file with an .fmw file extension. It can be run in either the Quick Translator or FME Workbench, but can only be opened for editing in Workbench.

Think of a workspace as the container for all the functionality of a translation.

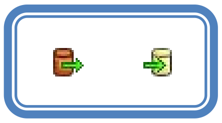
Readers and Writers
A *Reader* is the FME term for the component in a translation that reads a source dataset. Likewise, a *Writer* is the component that writes to a destination dataset.

Each reader and writer in a workspace handles just a single format of data. To read or write multiple formats requires the use of multiple readers and/or writers.


Navigator
MySourceData [MSSQL_SPATIAL]
MyDestinationData [POSTGIS]
Transformers
Bookmarks
User Parameters
Workspace Resources
Workspace Parameters
Workspace Properties
Workspace Search

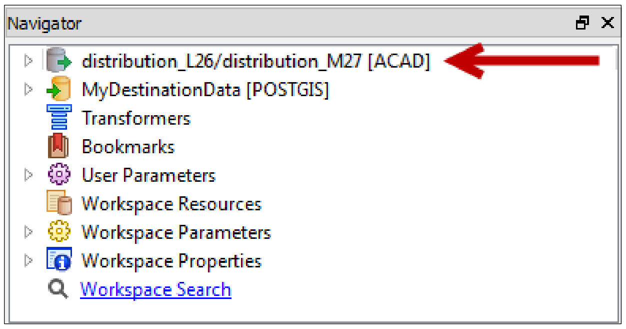
Readers and writers don’t appear as objects on the Workbench canvas, but are represented by entries in the Navigator window. Each reader and writer appears as a separate entry in the list.

Each item in the Navigator window is represented by an icon. The icons for readers and writers look like this:



The format of each reader and writer is denoted by the format keyword. In this example the reader format is SQL Server Spatial, and the writer format is PostGIS.

The “MySourceData” and “MyDestinationData” parts of the screenshot are the names of the datasets being read/written. When multiple datasets are read they are all listed, like in this AutoCAD reader.


Navigator
distribution_L26/distribution_M27 [ACAD]
MyDestinationData [POSTGIS]
Transformers
Bookmarks
User Parameters
Workspace Resources
Workspace Parameters
Workspace Properties
Workspace Search

Feature Types

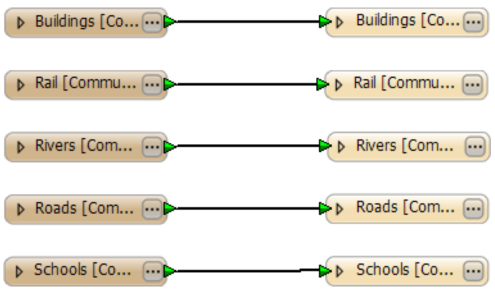
Feature Type is the FME term that describes an identifiable subset of records. Common alternatives for this term are ‘layer’, ‘table’, ‘feature class’, and ‘object class’.

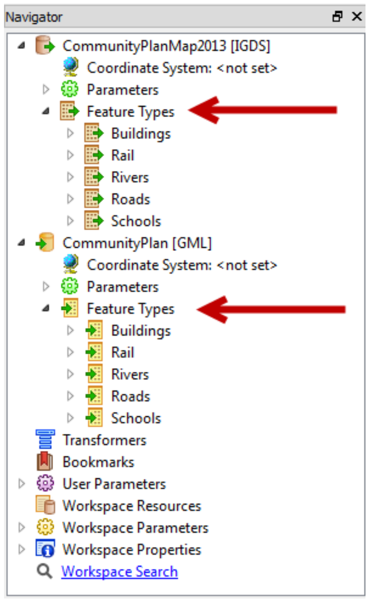
A Feature Type as a translation component is simply a defined layer in the process. If a specific layer is not defined by a feature type, then that data will not be either read and/or written.

Feature Types are represented by objects in the Workbench canvas, so it is easy to see at a glance which layers are represented, and where they are connected to in the translation.

Don’t confuse the term ‘Feature Type’ with ‘Geometry Type’.
Feature Type means “layer”; Geometry Type means “lines”, “points”, “polygons”.

In this workspace, feature types represent layers of source data called Buildings, Rail, Rivers, Roads, and Schools. The workspace canvas contains a different object for each feature type in both reader and writer.




Navigator
- CommunityPlanMap2013 [IGDS]
  - Coordinate System: <not set>
  - Parameters
  - Feature Types
    - Buildings
    - Rail
    - Rivers
    - Roads
    - Schools
- CommunityPlan [GML]
  - Coordinate System: <not set>
  - Parameters
  - Feature Types
    - Buildings
    - Rail
    - Rivers
    - Roads
    - Schools
- Transformers
- Bookmarks
- User Parameters
- Workspace Resources
- Workspace Parameters
- Workspace Properties
- Workspace Search

Beside canvas objects, feature types can be found listed in the Navigator window. They are the only component to be listed in two places in this way. This is because each feature type is always associated with a Reader/Writer

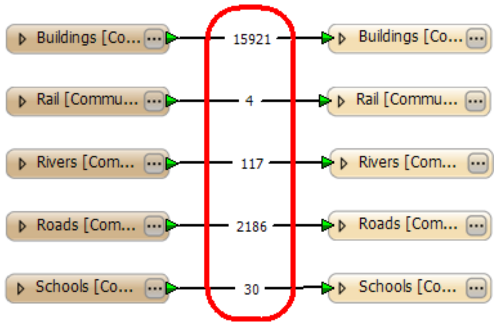
A writer feature type icon looks like this:

Features

Features are the smallest single components of an FME translation.

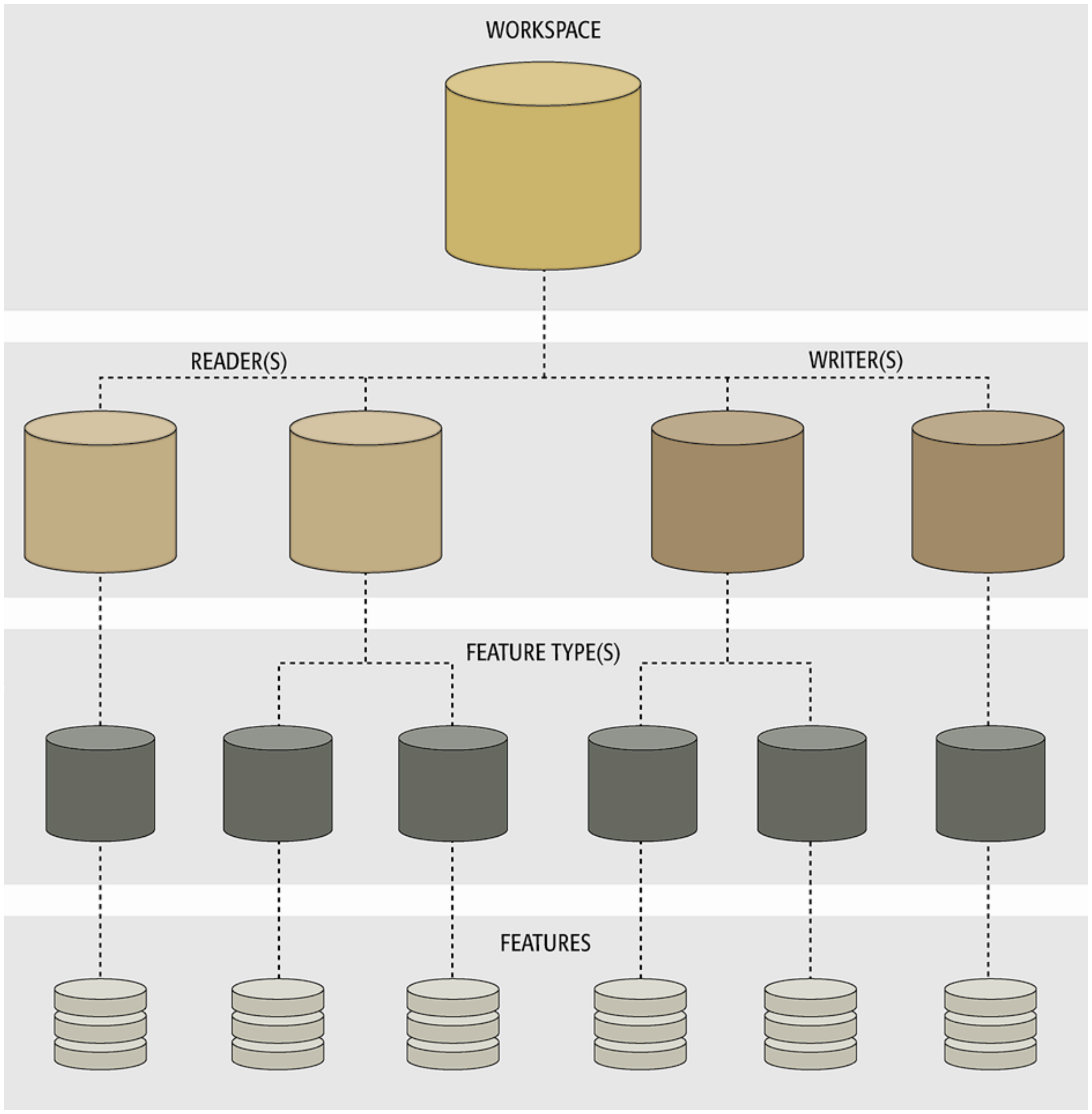
They aren’t individually represented within a workspace, except by the feature counts on a completed translation.

Here 2,186 road features were translated.



One-To-Many Relationships

The hierarchical relationship between workspace, readers, writers, feature types, and features is always one-to-many (1:M) with the level beneath:



Notice how a single workspace can contain any number of readers and writers, each reader can contain a number of feature types, and each feature type can contain any number of features within it.

Managing Components

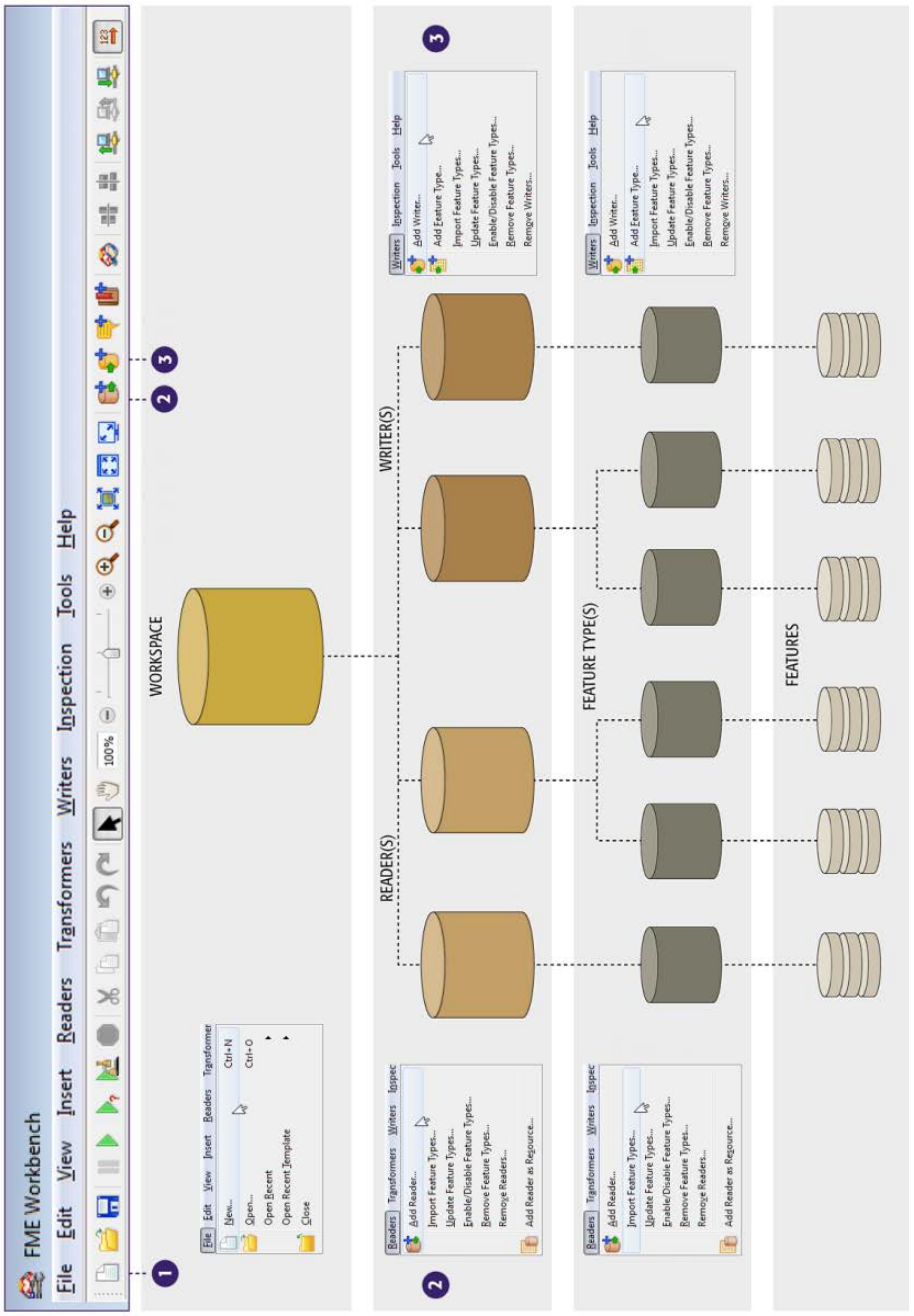
Managing Components 1

- Component Management Tools
- Create Workspace
- Add Reader/Writer
- Add Feature Types

There are a number of tools for creating or adding components to a translation.

Component Management Tools

All of the tools for managing components (creating, adding, or deleting) in a translation can be found on the FME Workbench menubar, as well as in some context-menus.



The list of tools for managing components in an FME translation is as follows:

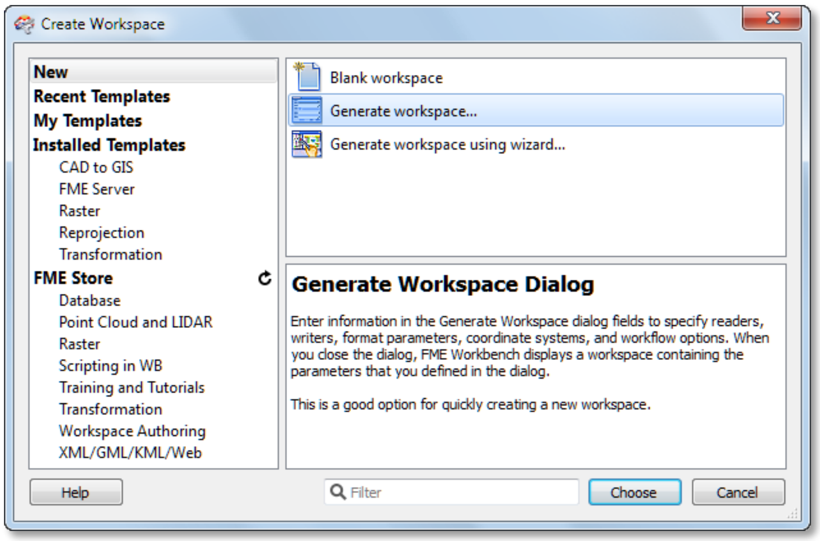
- Create Workspace
- Add Reader/Writer
- Add Feature Types
- Import Feature Types
- Remove Reader/Writer
- Remove Feature Types
- Update Feature Types
- Move Feature Types

Create Workspace

The most common way to start creating a translation definition is to create a workspace through one of the tools in FME Workbench.

File > **New** on the menubar opens up the Create Workspace dialog and provides a list of methods for creating a new workspace, or even starting out with a template workspace from an online source.

Creating a workspace through the **Generate** options is a simple way to define a translation because it includes reader, writer and feature type components in the setup process.



Generate Workspace Dialog

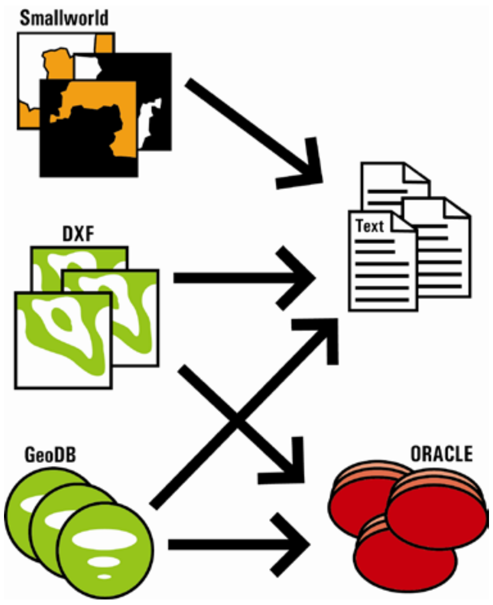
Enter information in the Generate Workspace dialog fields to specify readers, writers, format parameters, coordinate systems, and workflow options. When you close the dialog, FME Workbench displays a workspace containing the parameters that you defined in the dialog.

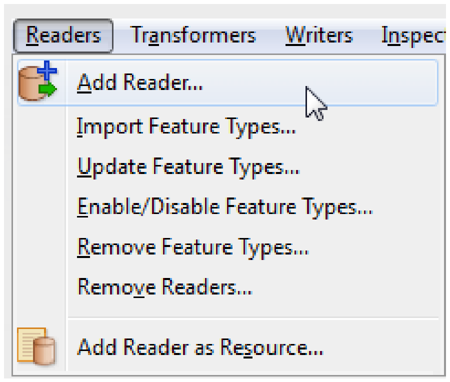
This is a good option for quickly creating a new workspace.

Add Reader/Writer
Adding a reader or writer to a workspace is a common requirement. There are several reasons:

- The Generate Workspace dialog only adds a single Reader and Writer
- Each Reader and Writer handles only one format of data.
- Different datasets (of the same format) may require handling with different parameters

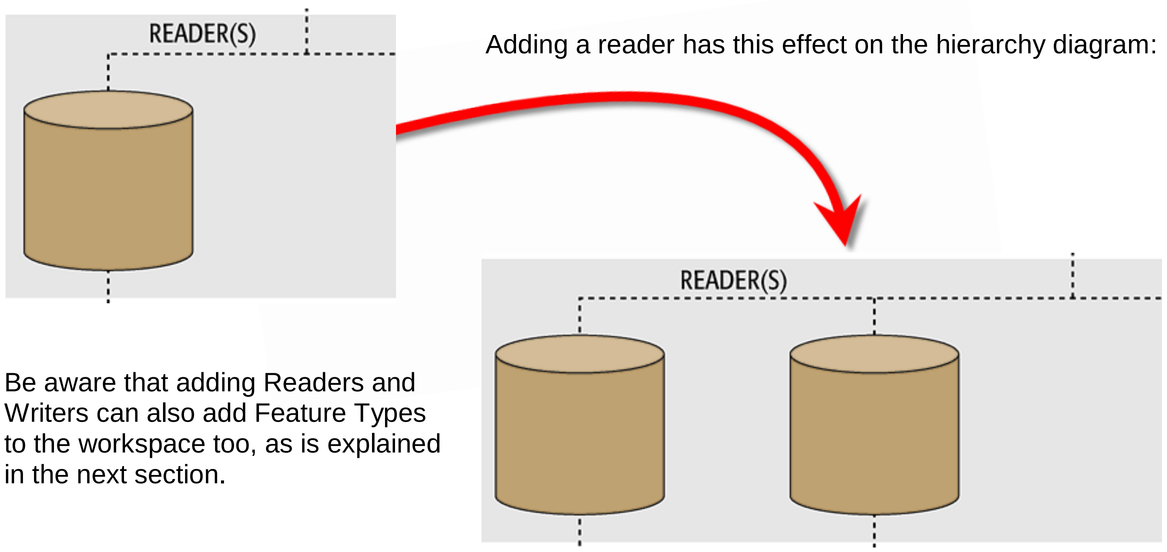
Therefore handling multiple formats of data – such as a workspace that reads Smallworld, DXF, and Geodatabase; and writes to both Oracle and a text file – requires multiple readers/writers.





Additional readers are added to a translation using **Readers** > **Add Reader** from the menubar. Similarly, additional writers are added using **Writers** > **Add Writer**

Adding a reader has this effect on the hierarchy diagram:



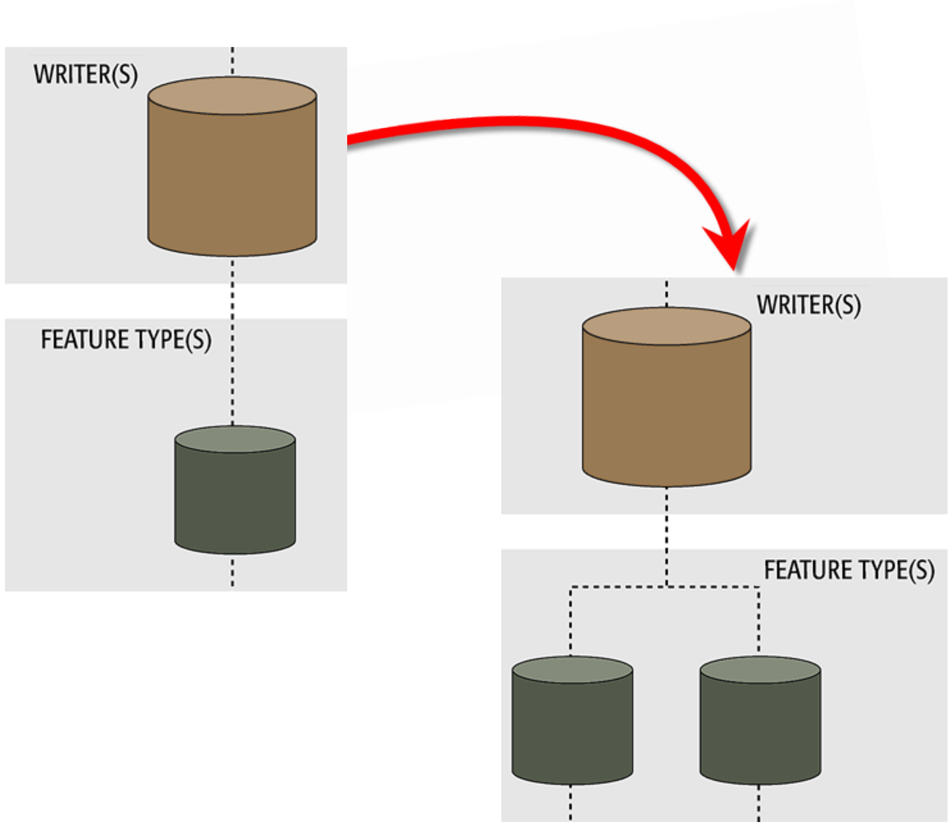
Be aware that adding Readers and Writers can also add Feature Types to the workspace too, as is explained in the next section.

Add Feature Types

Adding feature types can take place either when adding a reader/writer, or by a manual process.

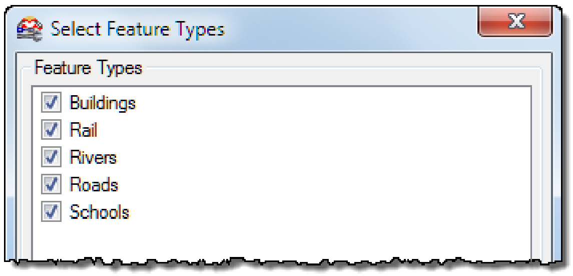
In general, manually adding a feature type is only permitted on the writer side of a translation. That's because the writer side is "What We Want" and is therefore open to manual editing.

Adding a feature type manually has this effect on the hierarchy diagram.

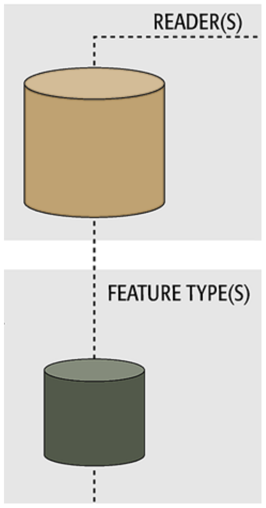


Adding Feature Types with a Reader

When adding a reader, FME will scan the chosen source data and prompt the user as to which source feature types should be added to the workspace.



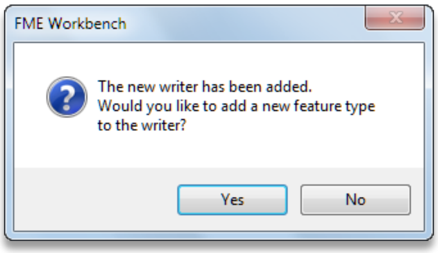
- [✓] Buildings
- [✓] Rail
- [✓] Rivers
- [✓] Roads
- [✓] Schools



Each chosen type – and not all have to be selected – will be represented by a feature type object below the new Reader.

Adding Feature Types with a Writer

When adding a writer, FME will offer a chance to manually add a new feature type.



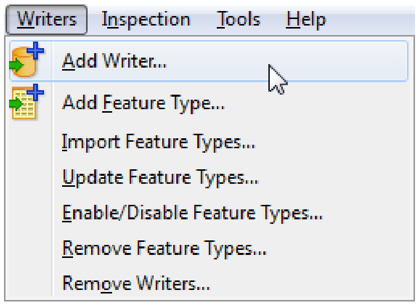
The new writer has been added.
Would you like to add a new feature type to the writer?

Responding yes to this question opens up the dialog for manually defining a new feature type. Only one feature type can be added at this time. Additional ones must be added manually.

No is the correct response when feature types are to be copied from a reader (see below) or imported from a different dataset (see next section).

Adding Manually

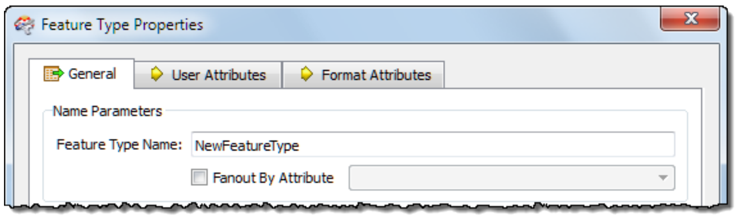
Feature Types can be added manually to a writer using **Writers** > **Add Feature Type** on the menubar.



Note that at least one writer must exist in the translation hierarchy; else this option will be greyed out.

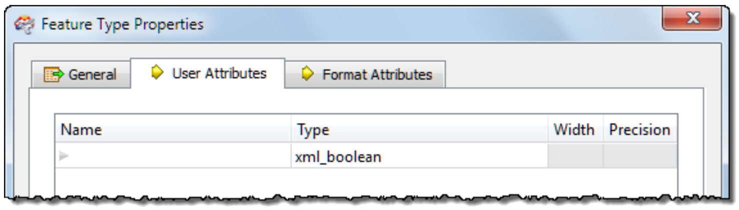
Choosing to add a feature type adds one to the translation, and then causes the Feature Type Properties dialog to appear in order to edit the feature type properties.

The General tab can be used to define the new feature type's name



Feature Type Name: NewFeatureType
Fanout By Attribute

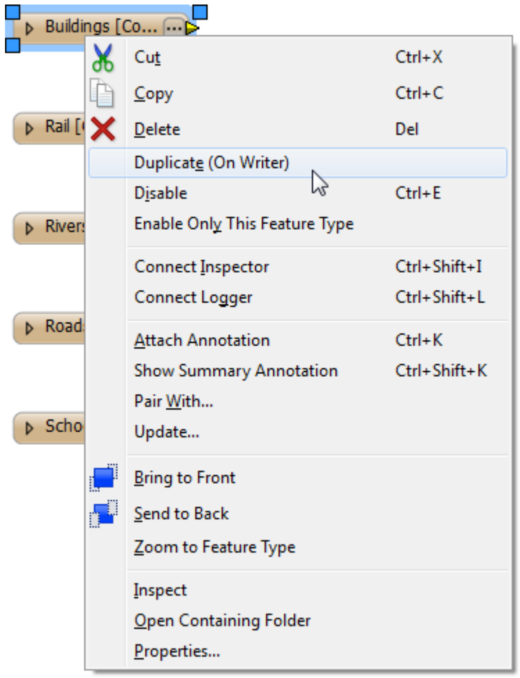
The User Attributes tab can be used to define the new Feature Type's attribute schema



Name	Type	Width	Precision
	xml_boolean		

Copying from a Reader

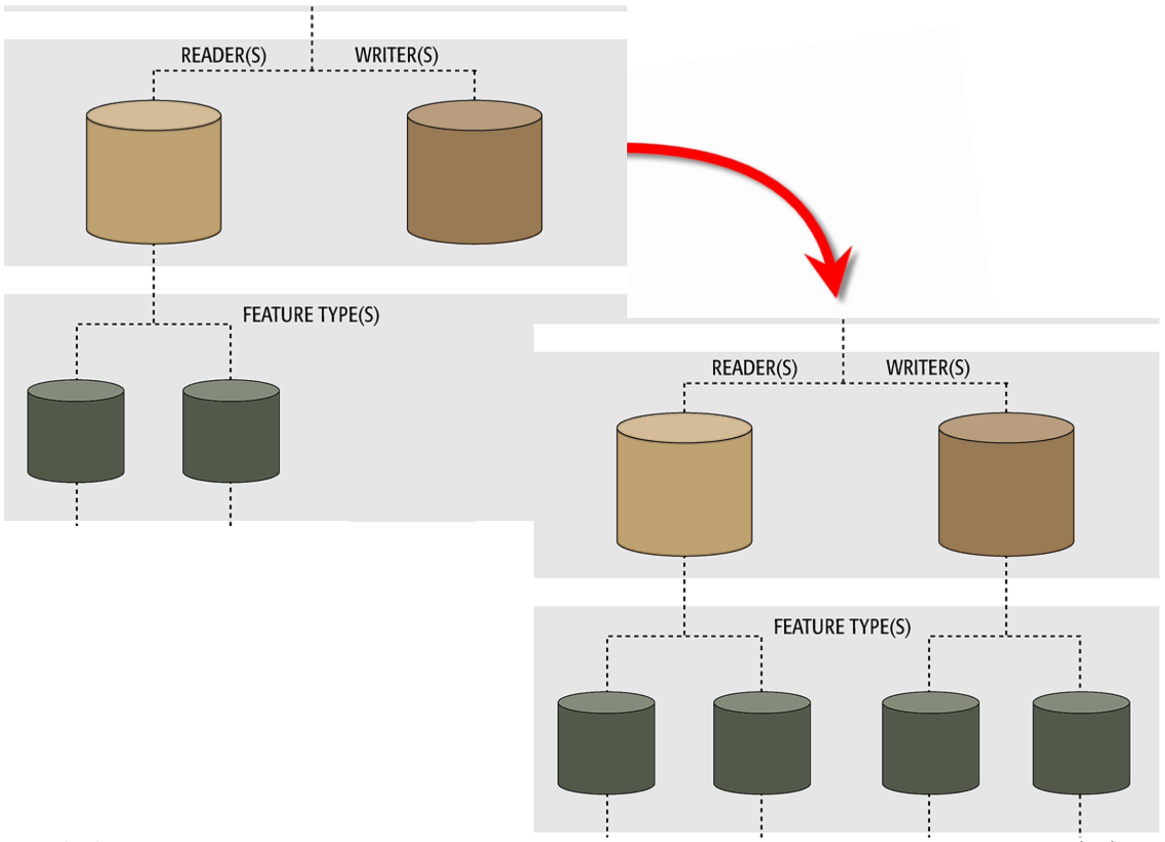
In some cases a user will have a reader with multiple feature types, and wish to add the same ones to a writer. This is simply done by selecting the source feature types, right-clicking them, and using the option **Duplicate (on Writer)**.



The command causes duplicates of the feature types to be added to the writer, and source/destination feature types to be automatically connected.

Again, at least one writer must exist in the translation hierarchy; else this option will be greyed out.

In the hierarchy diagram, copying feature types looks like this:



Example 7: Writing to MapInfo	
Scenario	FME user; City of Interopolis, Planning Department
Data	CSV format dataset of Cell Phone towers
Overall Goal	Create spatial data and extract information for use in Data Analytics
Demonstrates	Writing Data
Starting Workspace	C:\FMEData\Workspaces\DAManual\Example7Begin.fmw
Finished Workspace	C:\FMEData\Workspaces\DAManual\Example7Complete.fmw

Now we've read and processed the data, the natural progression is to write it to an output dataset.

1) Start Workbench
Start Workbench (if necessary) and open the workspace from Example 6.
Alternatively you can open *C:\FMEData\Workspaces\DAManual\Example7Begin.fmw*

Delete any existing Inspector transformers, as we'll be modifying the output now.

2) Add a Writer
Add a writer by selecting **Writers** > **Add Writer** from the menubar.

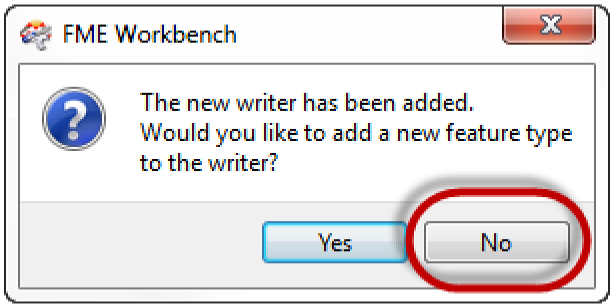
In the Add Writer dialog the following options:

Writer Format	MapInfo TAB (MFAL)
Writer Dataset	*C:\FMEData\Output\DAOutput*

There are no parameters for the MapInfo writer, so that button will remain inactive.

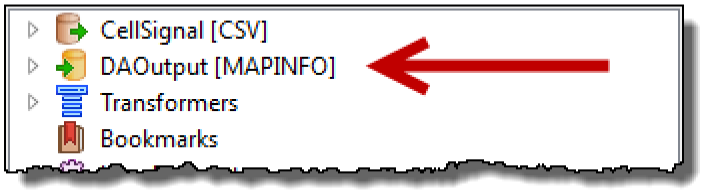
When prompted to add a new Feature Type, click **No**.

A Feature Type is needed, but we will define one another way.


FME Workbench

The new writer has been added.
Would you like to add a new feature type to the writer?

Yes [✓ No]

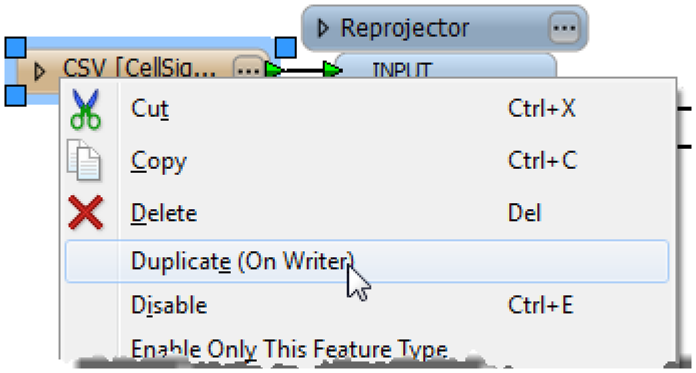


It may seem that nothing has happened – because there is no new content on the canvas – but a writer has been added and can be seen in the Navigator window.

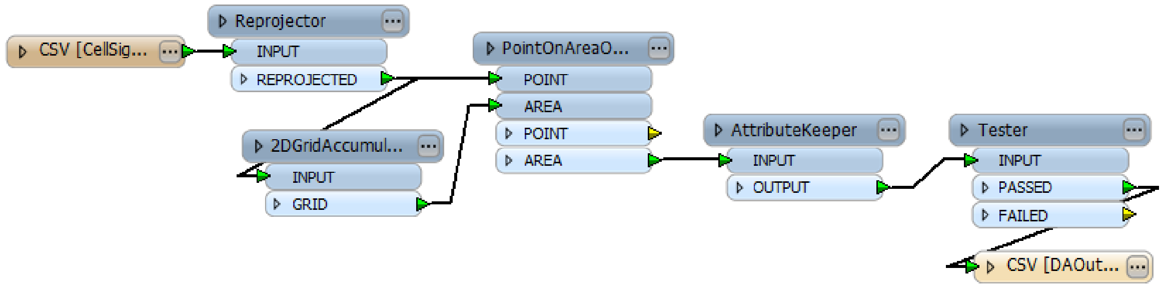
3) Define Feature Type

We'll define a Feature Type on the writer that is a copy of the reader one.

Right-click the CSV Reader Feature Type and choose **Duplicate (on Writer)**.
The source feature type will be duplicated on the writer and automatically connected.



However, we don't require a connection from the source, but from the Tester transformer, so delete any connection made to the Writer Feature Type, and connect it to the Tester PASSED output port.



4) Run translation

Save the workspace and then run the translation.

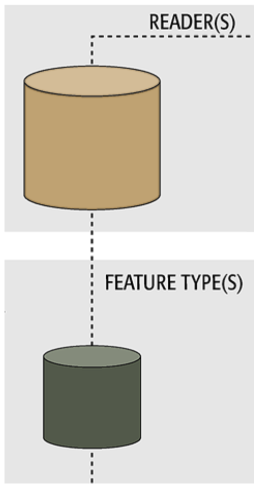
Open the output dataset in the FME Data Inspector to examine the contents.

Notice that any attributes with have a value of -9999. This is the default MapInfo value for an empty attribute. All attributes are empty because we've turned them into a list, but haven't yet updated the schema to match.

Import Feature Types

To understand importing feature types, it's important to recognize that "schema" is a separate entity, capable of being used and copied independently of any actions on the data itself.

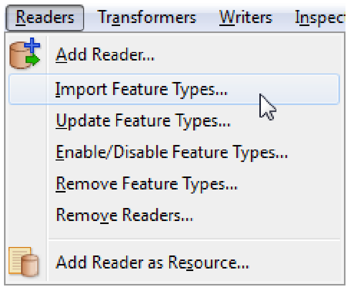
What the import tool does is essentially take a dataset's schema, and add it to a workspace.



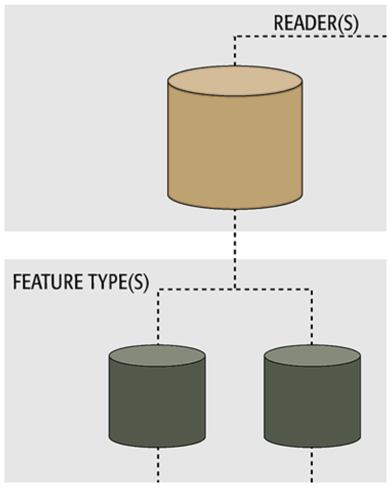
For example, a user has a workspace reading from a spatial database.

It only needs to read from a single table (roads), so there is a single Reader representing the database, and a single Feature Type representing the table.

However, at some future point the user decides the workspace also needs to read from a second table ('rail').



The simplest solution is to use the command **Readers** > **Import Feature Types…**



The import tool will take the schema definition of the database table 'rail' and add it to the workspace.

This is particularly important for a reader, because there is no "Add Feature Type" tool for a reader; the reason being that a source schema represents "What We Have" and adding user-defined definitions doesn't reflect that reality.

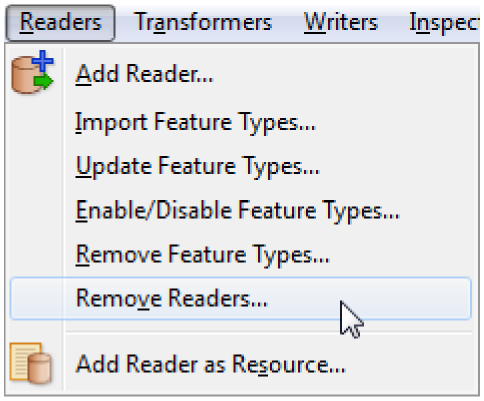
Interestingly, the import tool can import schemas from a dataset without that dataset being part of the actual translation. Even a different format is no impediment to using a schema this way.

For example, a user may wish to store table definitions in XML, importing feature types from the XML schema for use in writing to another format. A Spatial Data Infrastructure (SDI) with a rigidly defined schema, but open format specification, might be one use of this scenario.

It's always preferable to import feature types, or copy them from an existing Reader, rather than manually add them. That's because a manual process is slower and more prone to user error; especially when case sensitivity is an issue.

Remove Reader/Writer

Tools exist to remove a reader or writer from a workspace, both on the menubar and in context menus in the Navigator window.



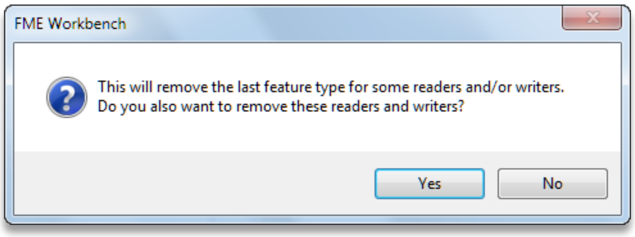
Note that whenever a reader or writer is removed, then all the related feature types will also be removed.

Remove Feature Types

This remove feature types function works at a lower level of the hierarchy than reader/writer removal, and just removes one or more feature types from the translation.

There is a menubar tool, but the easier method is to select the feature type(s) in the canvas and simply press the delete key on the keyboard.

Whenever all feature types are deleted from a Reader or Writer then FME will prompt the user to decide whether to remove the Reader/Writer as well.


FME Workbench

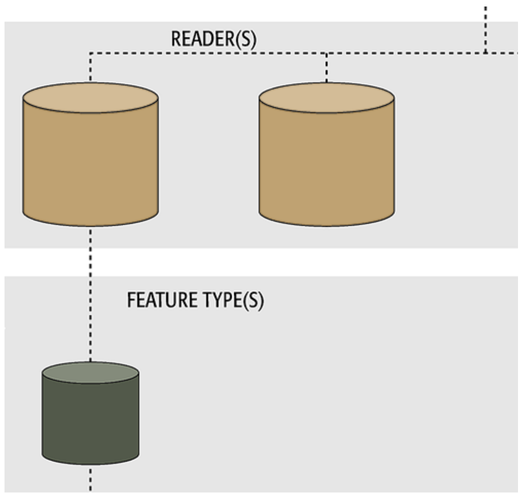
This will remove the last feature type for some readers and/or writers. Do you also want to remove these readers and writers?

If the feature types are all removed, and yet the Reader or Writer is left in the translation, then the hierarchy diagram has a "dangling" Reader/Writer.

A dangling reader/writer isn't a problem provided it's only a temporary situation; i.e. the user intends to now import or add new feature types.

The workspace should not be run in this condition!

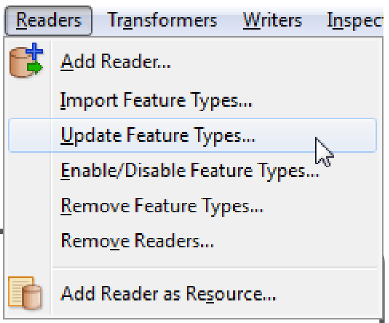
Performance suffers because all the source data is still being read. With a dangling reader it is discarded immediately, but with a dangling writer it is read and transformed too.



Update Feature Types
A frequent problem occurs when – after setting up a workspace – the structure of the source data changes; for example, a new attribute is added or the data type of an existing attribute is changed.

Because feature type definitions in Workbench can be adversely affected by underlying data changes, FME provides a way to update a workspace based on a new data structure.

Readers > **Update Feature Types** and **Writers** > **Update Feature Types** are the tools available to do this.



Both are a little like the Import Feature Type tool, except that the external schema is used to update a translation component of the same name, rather than to add a new one.

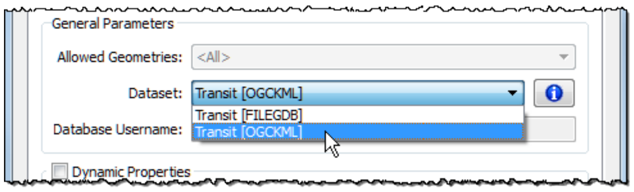
Use caution here – especially with CSV and Excel datasets. If you update a Reader/Writer using different parameters, then problems can occur when the translation is run.

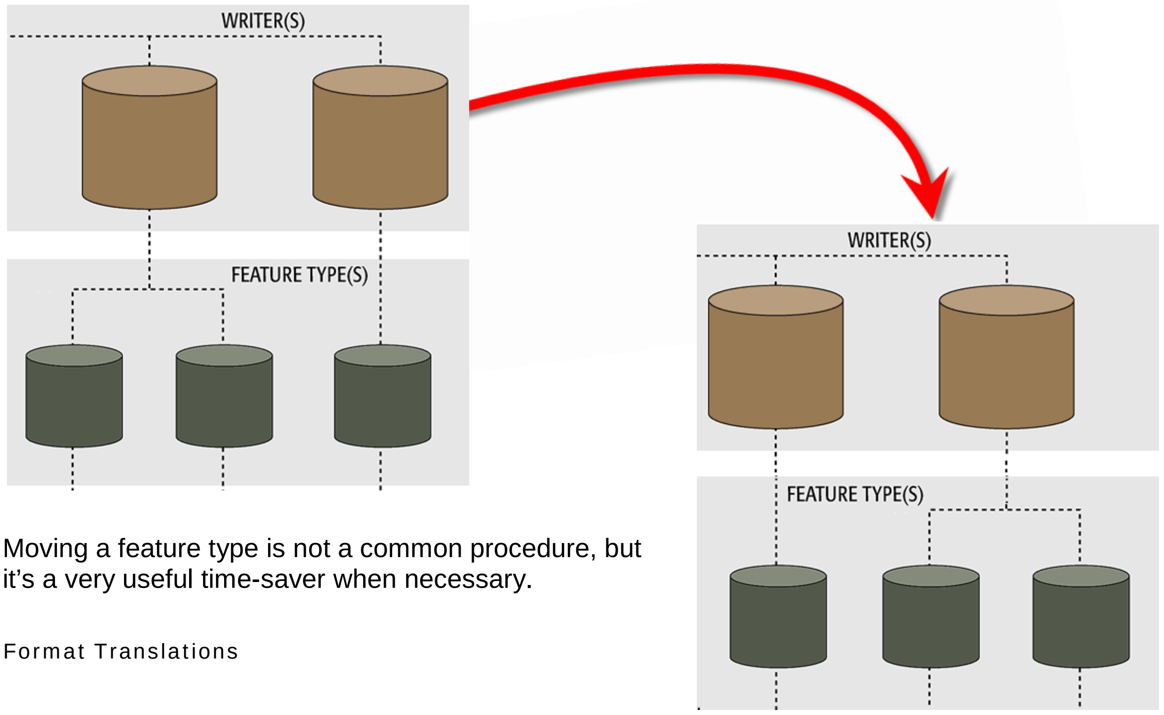
The safest solution is to delete the Reader/Writer and replace it with a new one.

Move Feature Types
As previously noted, a schema can be considered an independent object capable of being used for any reader/writer. This means there is no reason why feature types can't be moved from one writer to another, as and when required.

Whenever there are two or more writers, the Dataset setting in the writer Feature Type properties becomes active.

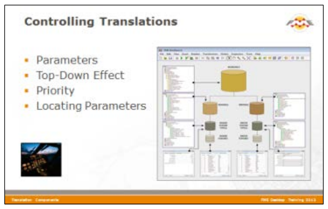
By changing this, the feature type is moved from one writer to another.


General Parameters
Allowed Geometries: <All>
Dataset: Transit [OGCKML]
Transit [FILEGDB]
Transit [OGCKML]
Database Username:
Dynamic Properties



Moving a feature type is not a common procedure, but it's a very useful time-saver when necessary.

Controlling Translations


Controlling Translations

- Parameters
- Top-Down Effect
- Priority
- Locating Parameters

Successfully translating from one format to another requires a firm grasp on all the parameters that control the translation.

Parameters are what control a translation.

Chef Bimm says…

"Parameters in a translation are like the options when you order a coffee.

You get to choose what ingredients you start with, how they are combined, and what the end result of the process will be like.

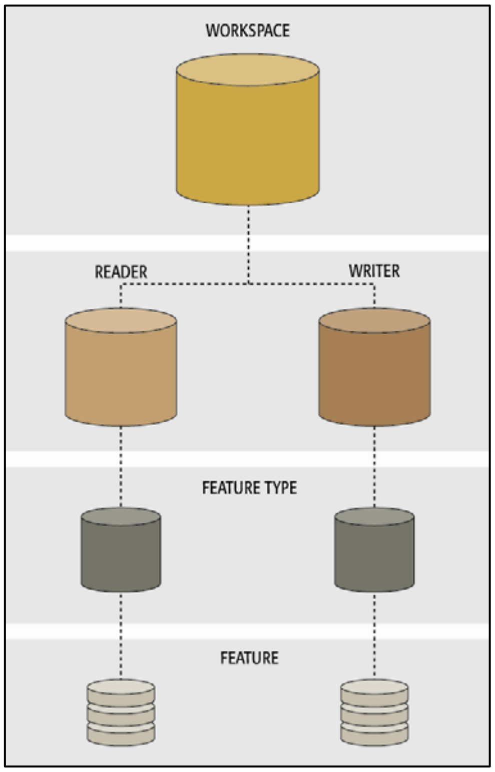
For example, the parameters in my coffee are decaf, grandé, extra-hot, no-whip, 2%, half-sweet, gingerbread latté! I always was very demanding."

In the hierarchy of different translation components, each different level of the hierarchy has a set of parameters that belong to it.

So there are:

- Workspace Parameters
- Reader Parameters
- Writer Parameters
- Feature Type Parameters
- Format Attributes (Feature Parameters)

Having parameters right down to the feature level provides a huge degree of control over every aspect of a translation.



Top-Down Effect
The basic rule is that any higher-level parameter affects every component below it.

For example, a Workspace Parameter affects all Readers and Writers, all Feature Types that belong to those Readers/Writers, and all features that belong to the Feature Types.

A Reader Parameter affects all Feature Types that belong to that particular reader, but not Feature Types belonging to another Reader.

To carry on Chef Bimm's analogy, if you load a coffee machine with Decaffeinated coffee, then all of the drinks will be decaffeinated (Workspace Parameter).

But, each drink can still separately include cream and sugar (Feature Type Parameter)

Priority
Priority is important because, in some cases, the same parameter exists at different levels.

Perhaps the best example of this is database writing mode.

Database writing mode (Insert, Update, or Delete) can be set firstly at the Writer level, in which case it applies to all tables and features. For example, if the writer level is set to INSERT then ALL features are written to tables as an insert.

But database writing mode can also be set at the Feature Type level, in which case it applies only to features written to that table. This allows different tables to have different modes.

Finally, database writing mode can be set on individual features. Different features can be used to insert, update, or delete records – simultaneously – in the same table.

Interestingly, the higher-up parameter only applies when the lower-down parameters are not set. When the same parameter is set at different levels, then the lower-level parameter wins out.

For example, a Writer might be set as INSERT mode; but a table is set to UPDATE mode. In that case the feature type level parameter wins out, and features are written to that table as an update.

Again it may help to return to the coffee maker analogy.

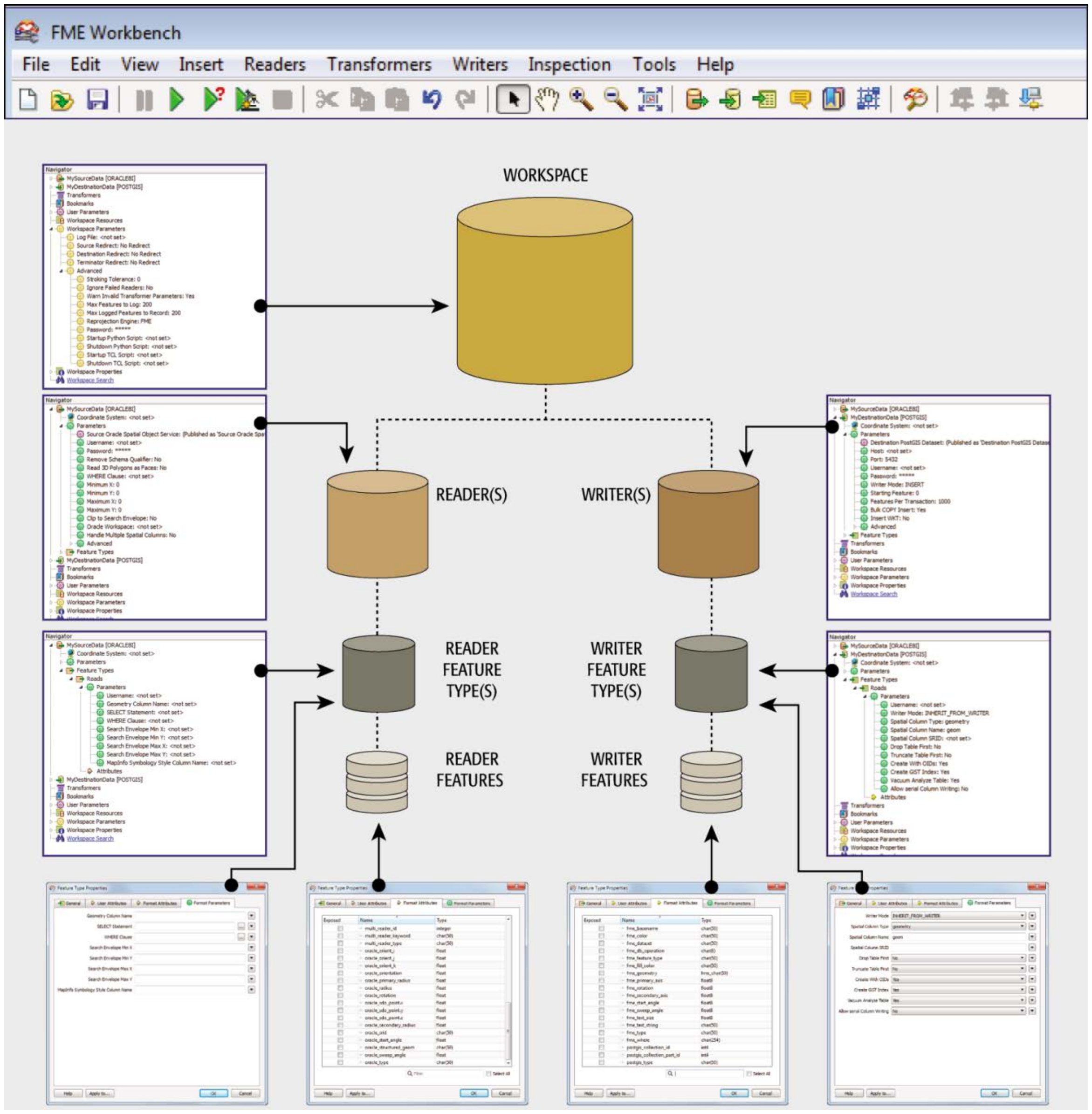
*The coffee machine may have a temperature option to set the temperature of drinks. This parameter (being at the top level) will apply to **all** drinks.*

However, there may also be a temperature override button as a drink is prepared.

Therefore, although the same temperature option occurs at each level, the lower level parameter takes priority (i.e. it overrides the higher-up parameter).

Locating Parameters

This diagram shows where the parameters are located for each translation component. Feature Types are interesting because their parameters are found in both the Navigator Window and the Feature Type Properties dialogs.



Parameter	Location
Workspace Parameters	Navigator Window
Reader and Writer Parameters	Navigator Window
Feature Type Parameters	Navigator Window *and* Feature Type Properties dialog
Format Attributes	Feature Type Properties dialog

As will be shown, although parameters to control features are *exposed* in the Feature Type Properties dialog, they are usually *set* using a transformer.

Workspace Parameters

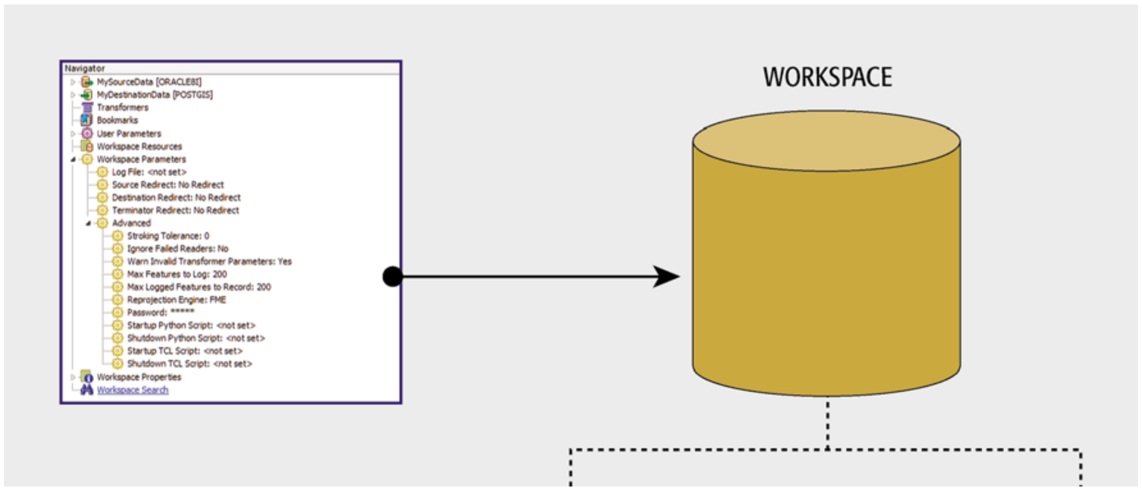
Workspace Parameters

- Basic Workspace Parameters
- Advanced Workspace Parameters

Workspace parameters relate to the workspace as a whole.

Workspace parameters (settings) are all of the parameters that relate to a workspace as a whole. They apply to the current workspace only and may change between workspaces.

Workspace parameters are shown and set in the Navigator Window.



Navigator
- MySourceData [ORACLE8I]
- MyDestinationData [POSTGIS]
- Transformers
- Bookmarks
- User Parameters
- Workspace Resources
- Workspace Parameters
  - Log File: <not set>
  - Source Redirect: No Redirect
  - Destination Redirect: No Redirect
  - Terminator Redirect: No Redirect
  - Advanced
    - Stroking Tolerance: 0
    - Ignore Failed Readers: No
    - Warn Invalid Transformer Parameters: Yes
    - Max Features to Log: 200
    - Max Logged Features to Record: 200
    - Reprojection Engine: FME
    - Password: *****
    - Startup Python Script: <not set>
    - Shutdown Python Script: <not set>
    - Startup TCL Script: <not set>
    - Shutdown TCL Script: <not set>
- Workspace Properties
- Workspace Search

The Workspace Parameters section contains settings that have an effect on how the translation is performed. Settings that provide information about a workspace such as Workspace Name and Workspace Description, but have no effect on the translation, are found in the Workspace Properties section.

For ease-of-use, workspace parameters are divided into two sections: basic and advanced.

Don't confuse Workspace Parameters with another set of Navigator items called Workspace Properties.

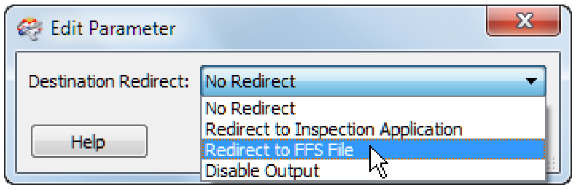
Workspace Properties are a set of metadata fields, including Workspace Name and Workspace Description, and have no direct effect on how a translation is carried out.

Basic Workspace Parameters

There are a number of basic workspace parameters. The most important one is Destination Redirect.

Destination Redirect

The Destination Redirect parameter overrides the Writer defined in the workspace. It causes FME to send the translation output elsewhere and no data is written to the destination datasets. To write output again the user must remove the redirect by choosing the No Redirect setting.



The destination redirect options are:

Redirect to Inspection Application: Output is sent directly to the FME Data Inspector.

Redirect to FFS File: Output is sent to an FFS (FME Feature Store) file.

Disable Output: Output is ignored and not used (similar to a NULL format writer).

'Redirect to Inspection Application' can also be found on the menu bar, under the Writers menu.

Advanced Workspace Parameters

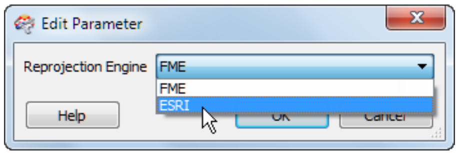
The advanced workspace parameters are perhaps not as valuable in everyday use, but have great importance in specific scenarios. Some particularly important ones are:

Ignore Failed Readers

This YES/NO parameter tells FME whether to continue a translation when reading a dataset fails. For example, if the wrong password is entered so that FME cannot read from a database, should the translation continue with any other datasets that FME was able to read from?

Reprojection Engine

Different GIS applications have slightly different algorithms for reprojecting data between different coordinate systems. To ensure that the data FME writes matches exactly to existing data, this parameter permits a user to use the reprojection engine from a different application.



Reprojection Engine: FME
FME
ESRI

A user with ArcGIS installed is choosing to use that package's engine for reprojecting the spatial data.

Password

It's often desirable to pass a workspace to an FME user for them to run, but not to edit. A password-protected workspace cannot be opened for editing in Workbench without the password. It can, however, still be run within the FME Universal Translator or from the command line.

Also, developers or consultants may want to pass on a workspace to an FME user without revealing the contents. Password protecting a workspace causes it to be encoded so that its contents cannot be read in a standard text editor.

Check for Missing Attribute References

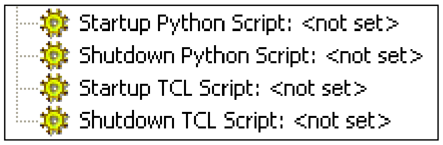
This parameter determines what happens when an attribute used to supply a value is deleted or otherwise removed, so that it becomes unavailable. In most cases the workspace user will wish to be alerted to this problem, so the default for this parameter is "Yes".

However, in some cases – for example as can occur in an older workspace – the attribute is not really "missing" but just invisible to FME. In this scenario, where the author is certain that such attributes do exist, then he/she may set this parameter to "No" to avoid unwanted error messages.

Start-up and Shutdown Scripts

These parameters deliver the ability to run a TCL or Python script before or after an FME translation.

Script parameters in the workspace settings dialog:



Startup Python Script: <not set>
Shutdown Python Script: <not set>
Startup TCL Script: <not set>
Shutdown TCL Script: <not set>

Potential uses of such scripts include:

- To check a database connection before running the translation
- To move data prior to or after the translation
- To write the translation results to a custom log or send them as e-mail to an administrator
- To run scripts from other applications; for example Esri ArcObjects Python scripts

Reader and Writer Parameters

Reader/Writer Parameters

- Reader Parameters
- Writer Parameters
  - Parameter Priority

Each reader or writer added to a workspace is controlled by a number of settings and parameters that are available.

Reader and Writer parameters are those that control how data is read and written.

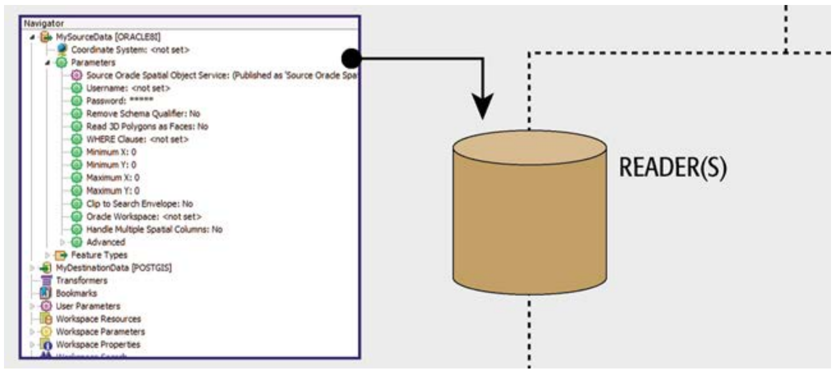
Because these parameters refer to specific components and characteristics of the related format, no two formats will have the same set of control parameters.

Also, because different parameters may be required, even the reader and writer of a single format may have different sets of parameters.

For ease-of-use, parameters are divided into two sections: basic and advanced.

Reader Parameters

Reader parameters are shown and set in the Navigator Window.
To edit a parameter, double-click it. A dialog opens up where the parameter's value may be set.



```
Navigator
MySourceData [ORACLE8I]
    Coordinate System: <not set>
    Parameters
        Source Oracle Spatial Object Service: (Published as 'Source Oracle Spa
        Username: <not set>
        Password: *****
        Remove Schema Qualifier: No
        Read 3D Polygons as Faces: No
        WHERE Clause: <not set>
        Minimum X: 0
        Minimum Y: 0
        Maximum X: 0
        Maximum Y: 0
        Clip to Search Envelope: No
        Oracle Workspace: <not set>
        Handle Multiple Spatial Columns: No
        Advanced
    Feature Types
MyDestinationData [POSTGIS]
Transformers
Bookmarks
User Parameters
Workspace Resources
Workspace Parameters
Workspace Properties
```

Doctor Workbench says…

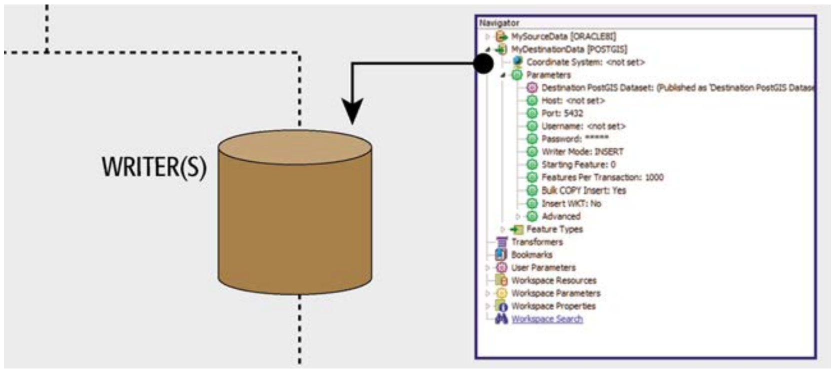
'Some Reader (and Writer) parameters are ONLY accessible through the Parameters button when you initially create a workspace or add the Reader/Writer to an existing workspace. That's because they affect how the schema is read and therefore how the workspace is constructed.

It's like preparing a patient for surgery. Once the workspace (patient) is created (prepped) those parameters aren't available because you're past the point where they would have any effect.

Of course, sometimes you get such a parameter wrong, in which case you simply recreate the workspace. Or find yourself a new patient!

Writer Parameters

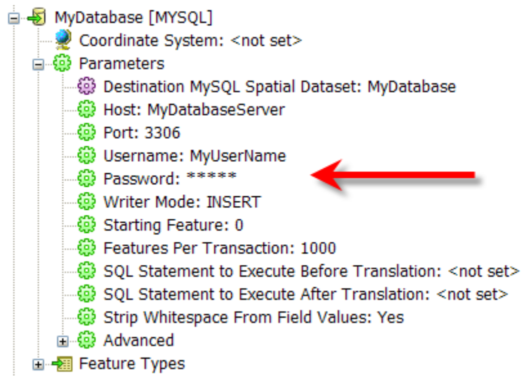
Writer parameters are shown and set in the Navigator Window.
To edit a parameter, double-click it. A dialog opens up where the parameter's value may be set.



```
Navigator
MySourceData [ORACLE8I]
MyDestinationData [POSTGIS]
    Coordinate System: <not set>
    Parameters
        Destination PostGIS Dataset: (Published as 'Destination PostGIS Datase
        Host: <not set>
        Port: 5432
        Username: <not set>
        Password: *****
        Writer Mode: INSERT
        Starting Feature: 0
        Features Per Transaction: 1000
        Bulk COPY Insert: Yes
        Insert WKT: No
        Advanced
    Feature Types
Transformers
Bookmarks
User Parameters
Workspace Resources
Workspace Parameters
Workspace Properties
Workspace Search
```

Parameter Priority

It's worth emphasizing that, because Readers and Writers are at a relatively high level in the translation hierarchy, their parameters apply to everything beneath them; that is, ALL features types and ALL features.



```
MyDatabase [MYSQL]
    Coordinate System: <not set>
    Parameters
        Destination MySQL Spatial Dataset: MyDatabase
        Host: MyDatabaseServer
        Port: 3306
        Username: MyUserName
        Password: *****
        Writer Mode: INSERT
        Starting Feature: 0
        Features Per Transaction: 1000
        SQL Statement to Execute Before Translation: <not set>
        SQL Statement to Execute After Translation: <not set>
        Strip Whitespace From Field Values: Yes
        Advanced
    Feature Types
```

Database Password is a good example of a Reader/Writer-level parameter.

A database user password is something that applies to ALL tables being read.

<u>There isn't a different password per table</u>!
Therefore it is a Reader/Writer level parameter.

Example 8: Data Previews	
Scenario	FME user; City of Interopolis, Planning Department
Data	CSV format dataset of Cell Phone towers
Overall Goal	Create spatial data and extract information for use in Data Analytics
Demonstrates	Previewing Data
Starting Workspace	C:\FMEData\Workspaces\DAManual\Example8Begin.fmw
Finished Workspace	C:\FMEData\Workspaces\DAManual\Example8Complete.fmw

Sometimes it's better to run a workspace without writing any output – for example when you are testing a workspace and don't want to overwrite existing data (particularly in a database). FME allows you to do this by automatically redirecting the output elsewhere.

1) Start Workbench
Start Workbench (if necessary) and open the workspace from Example 7.
Alternatively you can open *C:\FMEData\Workspaces\DAManual\Example8Begin.fmw*

2) Redirect to Inspector
In the Navigator window, locate and check the workspace parameter 'Destination Redirect'.
At the moment it will be set to 'No Redirect'.

Changing this setting to 'Redirect to Inspection Application' is the equivalent to using **Writers** > **Redirect to Inspection Application**. In fact, you can try this to show how changing one automatically affects the other.

Changing the Destination Redirect setting to 'Disable Output' prevents writing any data to the destination dataset or to FME Data Inspector. In effect, you're running the workspace up until the writers take effect, testing the reading and transformation steps of the translation.

Experiment with setting the Destination Redirect option to either Redirect to Inspection Application or Disable Output, and running the workspace. Do you notice anything about what attributes exist compared to inspecting the actual output dataset?

Notice that disabling the output or redirecting it to the Data Inspector, does not remove any existing output dataset. i.e. if you have already written the data, running the workspace again with disabled output will NOT remove the output from the previous run.

In short, FME will never delete a dataset unless it is overwriting that file.

Feature Type Parameters

Feature Type Parameters

- Reader Feature Type Parameters
- Writer Feature Type Parameters

Each reader or writer added to a workspace is controlled by a number of settings and parameters that are available.

Feature Type Parameters

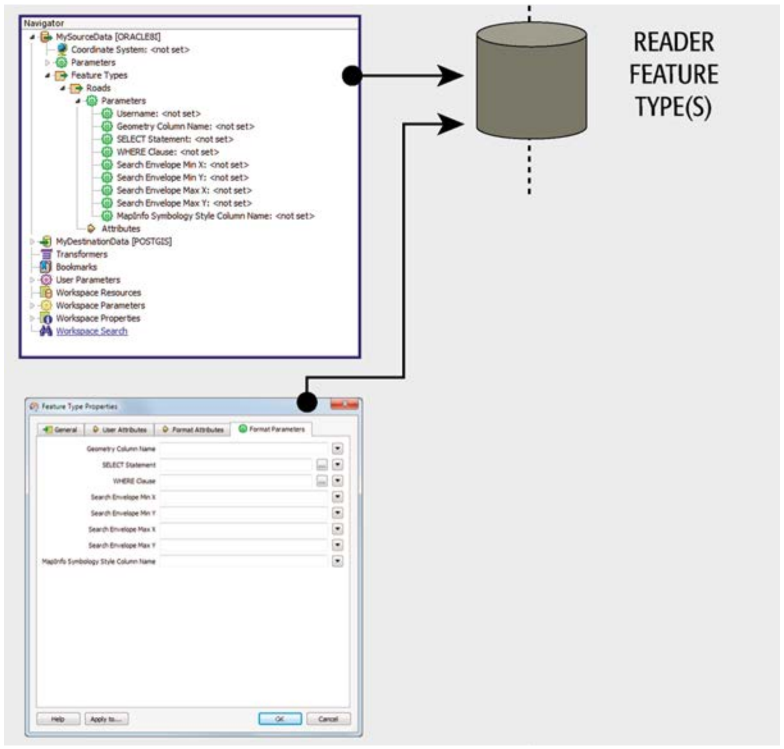
Feature Types are at a lower level in the hierarchy than readers and writers.

Therefore, Feature Type parameters don't apply to datasets as a whole, but only to individual feature types within a dataset. They provide a degree of individual control over reading and writing different layers or tables.

Reader Feature Type Parameters

Reader feature type parameters apply to *reading* of specific layers/tables.

A general rule is that database formats have reader feature type parameters, but few file-based formats do.



```
Navigator
MySourceData [ORACLE8I]
    Coordinate System: <not set>
    Parameters
    Feature Types
        Roads
            Parameters
                Username: <not set>
                Geometry Column Name: <not set>
                SELECT Statement: <not set>
                WHERE Clause: <not set>
                Search Envelope Min X: <not set>
                Search Envelope Min Y: <not set>
                Search Envelope Max X: <not set>
                Search Envelope Max Y: <not set>
                MapInfo Symbology Style Column Name: <not set>
            Attributes
MyDestinationData [POSTGIS]
Transformers
Bookmarks
User Parameters
Workspace Resources
Workspace Parameters
Workspace Properties
Workspace Search
```

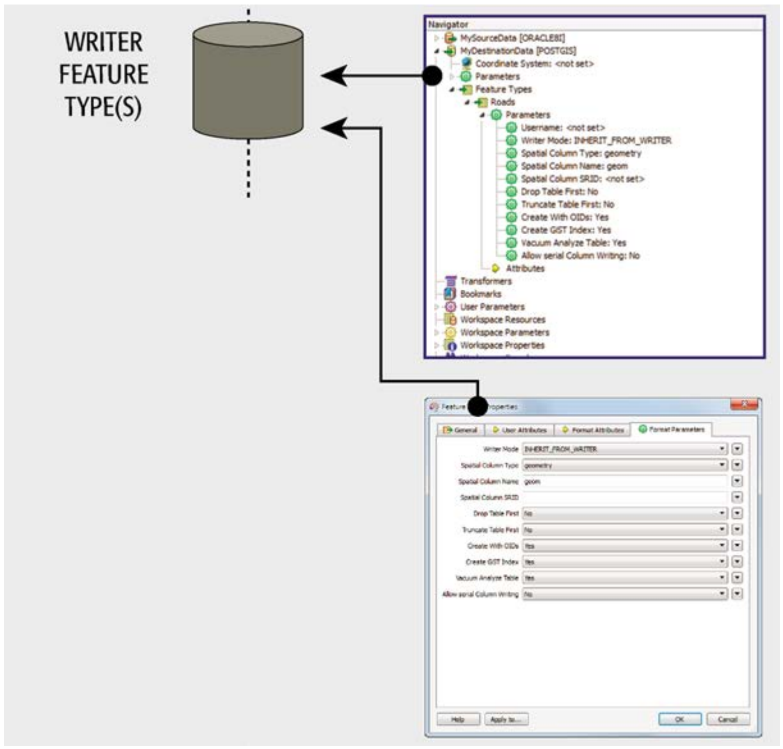
*Feature Type Parameters can also be accessed through the Feature Type Properties dialog. Notice the tab named **Format Parameters**.*

Not all feature types have parameters, so this tab is not always present.

Writer Feature Type Parameters

Writer feature type parameters apply to *writing* of specific layers/tables.

Again, most database formats have writer feature type parameters, but a high proportion of file-based formats also have these.



Navigator
- MySourceData [ORACLE8I]
- MyDestinationData [POSTGIS]
  - Coordinate System: <not set>
  - Parameters
  - Feature Types
    - Roads
      - Parameters
        - Username: <not set>
        - Writer Mode: INHERIT_FROM_WRITER
        - Spatial Column Type: geometry
        - Spatial Column Name: geom
        - Spatial Column SRID: <not set>
        - Drop Table First: No
        - Truncate Table First: No
        - Create With OIDs: Yes
        - Create GiST Index: Yes
        - Vacuum Analyze Table: Yes
        - Allow serial Column Writing: No
      - Attributes
- Transformers
- Bookmarks
- User Parameters
- Workspace Resources
- Workspace Parameters
- Workspace Properties

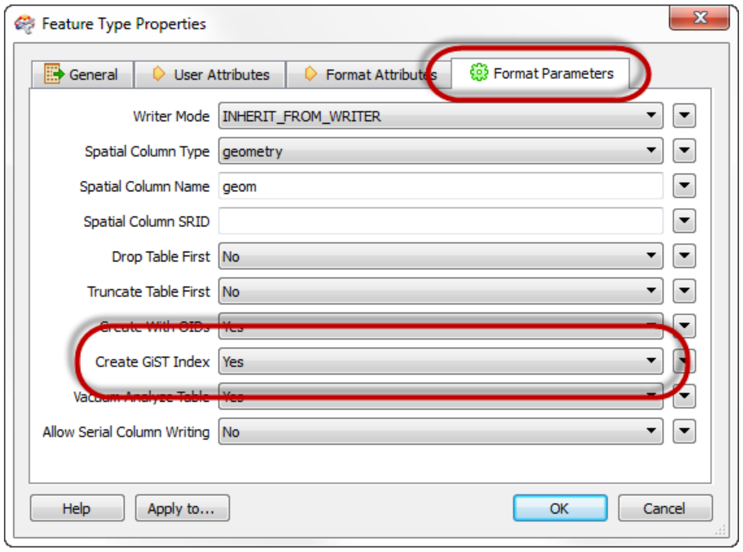
Create Spatial Index is a good example of a feature type parameter.

The decision about whether or not to apply an index is made on a table-by-table basis.

Not all tables may require an index. There can be a different index per table.

Therefore this is a feature type parameter.

If it were a writer-level parameter, then ALL tables would get an index; not necessarily what the user wants.



Writer Mode	INHERIT_FROM_WRITER
Spatial Column Type	geometry
Spatial Column Name	geom
Spatial Column SRID	
Drop Table First	No
Truncate Table First	No
Create With OIDs	Yes
Create GiST Index	Yes
Vacuum Analyze Table	Yes
Allow Serial Column Writing	No

Conversely, no password parameter is listed because it applies to the entire database, not the individual tables.

Format Attributes

Format Attributes

- Format Attributes
- FME Attributes
- Controlling Features
  - Exposing Format Attributes
  - Filtering with Format Attributes
  - Transforming with Format Attributes

Besides 'user attributes' there is a whole range of attributes created by FME: Format Attributes

Although features are the lowest level in the hierarchy of translation components, it's very useful to be able to control and manipulate individual features.

However, control of features isn't done using parameters, but instead with a constituent part of features called Format Attributes.

Format Attributes

A format attribute is a built-in, FME-generated attribute. It represents part of the structure of a feature for any given format; i.e. information that isn't generally carried as part of the geometry or as a user attribute. The color of a feature is one example of information held by format attributes.

FME uses these format attributes to keep track of such information and make sure it is passed on correctly to a destination dataset.

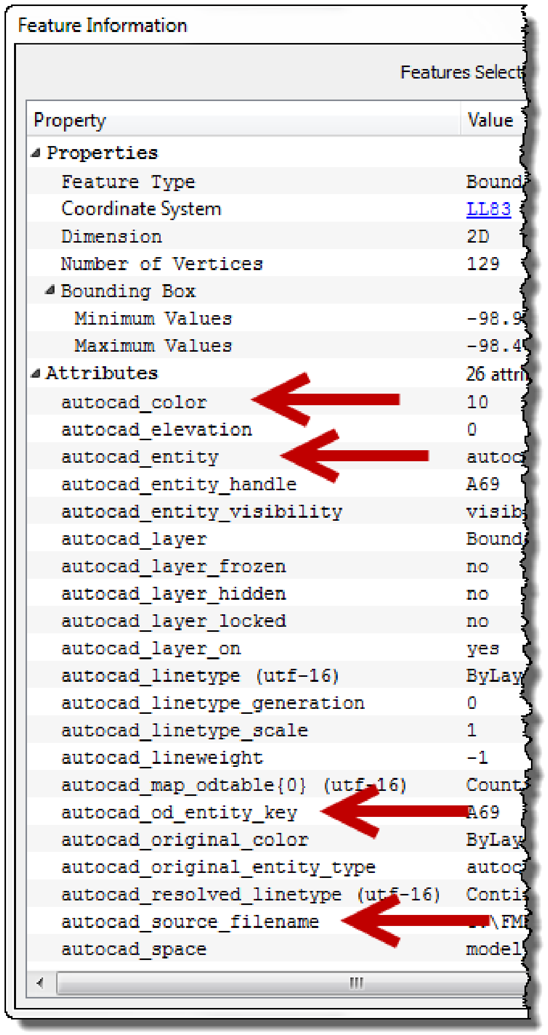
Format attributes are most obvious when viewing a dataset with FME Data Inspector. Querying a feature causes both user attributes and format attributes to be reported.

For example, inspecting AutoCAD Map3D Object data in the FME Data Inspector will show many format attributes, such as:

- autocad_color: Color of the feature
- autocad_entity: Type of geometry
- autocad_od_entity_key: Object Data ID
- autocad_source_filename: Source file

Other features, such as a point geometry, might have a format attribute to record rotation, while an arc feature would have format attributes to record arc length and angle.

Notice how the attribute name starts with a format keyword, to differentiate the same format attributes for different formats of data.



Feature Information

Features Select

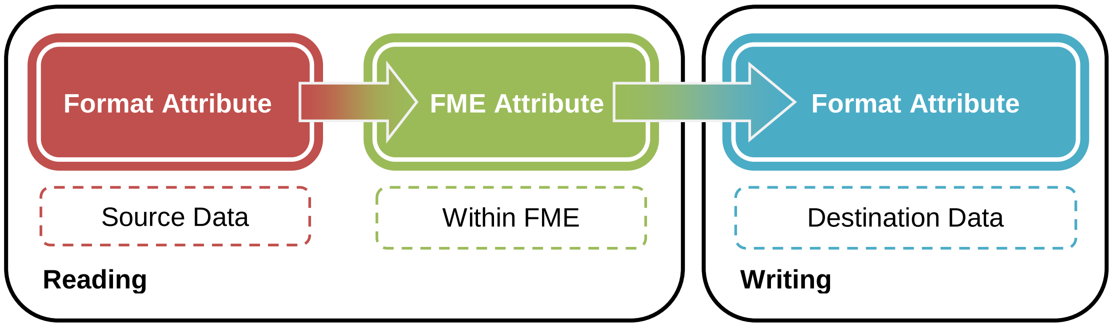
Property	Value
Properties	
Feature Type	Bound
Coordinate System	LL83
Dimension	2D
Number of Vertices	129
Bounding Box	
Minimum Values	-98.9
Maximum Values	-98.4
Attributes	26 attri
autocad_color	10
autocad_elevation	0
autocad_entity	autoc
autocad_entity_handle	A69
autocad_entity_visibility	visib
autocad_layer	Bound
autocad_layer_frozen	no
autocad_layer_hidden	no
autocad_layer_locked	no
autocad_layer_on	yes
autocad_linetype (utf-16)	ByLay
autocad_linetype_generation	0
autocad_linetype_scale	1
autocad_lineweight	-1
autocad_map_odtable{0} (utf-16)	Count
autocad_od_entity_key	A69
autocad_original_color	ByLay
autocad_original_entity_type	autoc
autocad_resolved_linetype (utf-16)	Conti
autocad_source_filename	\FM
autocad_space	model

FME Attributes

A particular set of Format Attributes has the prefix **fme_**. These attributes represent the data as it is perceived by FME and are sometimes known as FME Attributes or Generic FME Attributes.

When a translation is carried out, the following occurs:

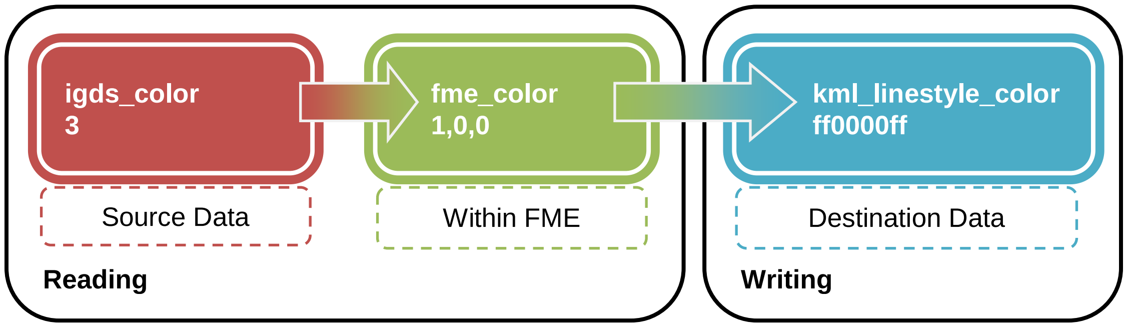
- FME reads the source data and stores information about its features as format attributes. These format attributes reflect the data that is stored in the original source data.
- FME converts the source data's format attributes into FME Attributes. These FME attributes reflect the source data as it is perceived within FME.
- FME writes the destination data by creating a new set of format attributes. These format attributes reflect the information as it will be stored in the destination data.



This is why, when a user inspects data, there are two sets of attributes. In the previous screenshot were both *autocad_color* and *fme_color;* the latter is the FME representation of the former.

Using this method, FME can convert from one format to another, without having to separately map the source format attributes to the destination format attributes for every format.

FME merely converts everything to an FME standard and then from there to the Writer Format.



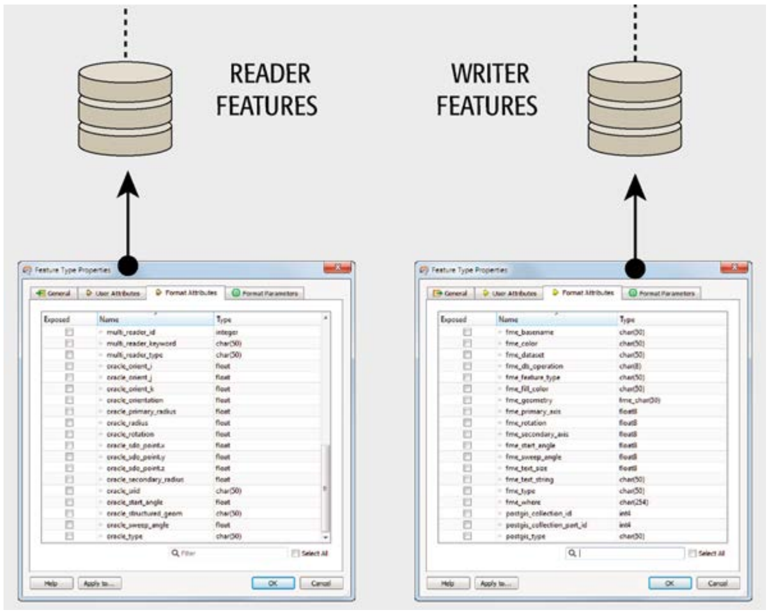
Controlling Features with Format Attributes

A user can make use of these attributes to carry out certain tasks by making the attributes part of the workspace.

As mentioned, a user doesn't have direct control over features with parameters, but instead uses format attributes.

However, to avoid cluttering the workspace these attributes are not all visible by default.

To make them visible is known as "exposing" them, and involves the Feature Types Properties dialog.



Feature Type Properties — General | User Attributes | Format Attributes | Format Parameters

Exposed	Name	Type
☐	multi_reader_id	integer
☐	multi_reader_keyword	char(50)
☐	multi_reader_type	char(50)
☐	oracle_orient_i	float
☐	oracle_orient_j	float
☐	oracle_orient_k	float
☐	oracle_orientation	float
☐	oracle_primary_radius	float
☐	oracle_radius	float
☐	oracle_rotation	float
☐	oracle_sdo_point.x	float
☐	oracle_sdo_point.y	float
☐	oracle_sdo_point.z	float
☐	oracle_secondary_radius	float
☐	oracle_uid	char(50)
☐	oracle_start_angle	float
☐	oracle_structured_geom	char(50)
☐	oracle_sweep_angle	float
☐	oracle_type	char(50)

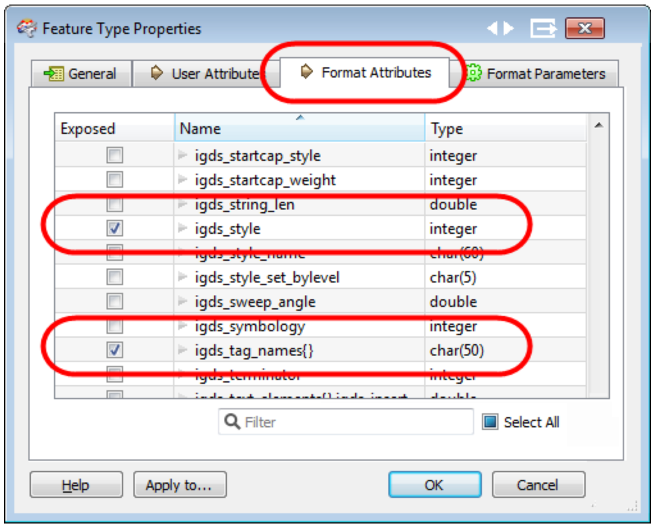
Feature Type Properties — General | User Attributes | Format Attributes | Format Parameters

Exposed	Name	Type
☐	fme_basename	char(50)
☐	fme_color	char(50)
☐	fme_dataset	char(50)
☐	fme_db_operation	char(8)
☐	fme_feature_type	char(50)
☐	fme_fill_color	char(50)
☐	fme_geometry	fme_char(50)
☐	fme_primary_axis	float8
☐	fme_rotation	float8
☐	fme_secondary_axis	float8
☐	fme_start_angle	float8
☐	fme_sweep_angle	float8
☐	fme_text_size	float8
☐	fme_text_string	char(50)
☐	fme_type	char(50)
☐	fme_where	char(254)
☐	postgis_collection_id	int4
☐	postgis_collection_part_id	int4
☐	postgis_type	char(50)

Exposing Format Attributes

To expose a format attribute, open the Feature Type Properties dialog, and click the 'Format Attributes' tab. Locate the Format Attribute to expose and check the box provided. Click OK to make the format attribute available for use within Workbench.

Format attributes might be a single attribute (for example, igds_style) or they might be a list-based format attribute, for example (igds_tag_names{})



Exposed	Name	Type
☐	igds_startcap_style	integer
☐	igds_startcap_weight	integer
☐	igds_string_len	double
✓	igds_style	integer
☐	igds_style_name	char(60)
☐	igds_style_set_bylevel	char(5)
☐	igds_sweep_angle	double
☐	igds_symbology	integer
✓	igds_tag_names{}	char(50)
☐	igds_terminator	integer

Firefighter Mapp says…

'An alternate method is to use the AttributeExposer transformer.'

Filtering with Format Attributes

One primary use of format attributes is as a means of filtering and directing source data within a workspace.

For example, suppose features in a source AutoCAD dataset are not divided into different layers as they should be. Because the user is able to determine the proper layer from maybe the color of the feature or the size of a text entity, they can expose the format attributes *autocad_color* or *autocad_text_size,* and use them to interpret the correct layer.

Most "filter" transformers (described in more detail in Chapter 6) can be used to process data in this way.

List Format Attributes

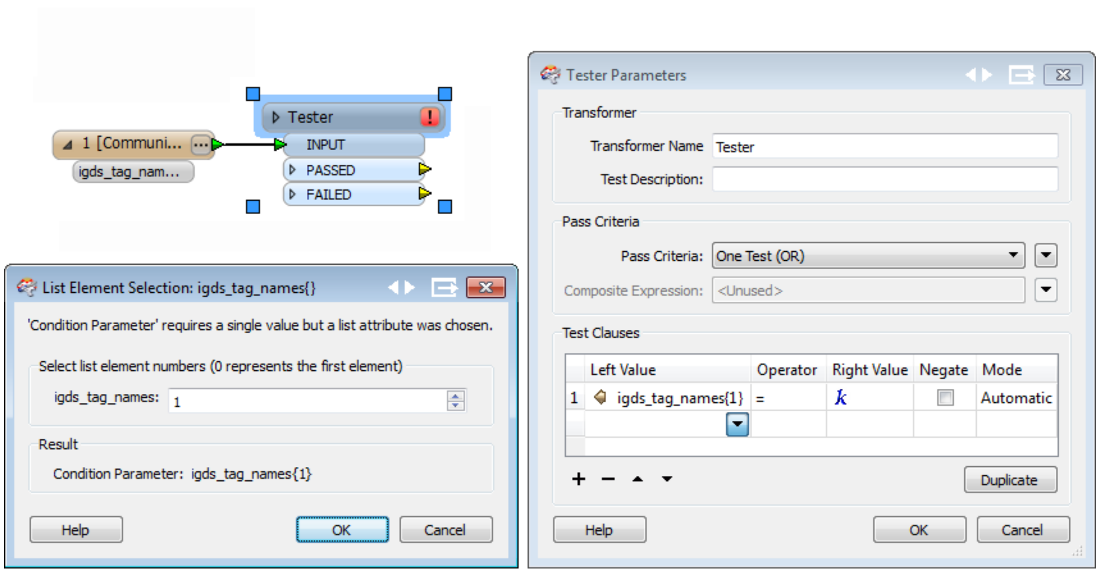
A List attribute is an FME structure that allows multiple values for each attribute. For example, an area of forestry might have a list of tree types (Pine, Oak, Cedar) in which case a list attribute in FME might be something like:

parcelList.treeType{0} = Pine, parcelList.treeType{1} = Oak, parcelList.treeType{2} = Cedar

This is important here because some format attributes can also be a list type of attribute.

In this example, the user has exposed the list format attribute igds_tag_names{}

When they attempt to use that attribute in a *Tester* transformer, they are prompted to choose which element in the list is to be tested. Because transformer dialogs ask which element in a list is to be used, it's not necessary to have to expose multiple elements solely to get access to a single one.



List Element Selection: igds_tag_names{}

'Condition Parameter' requires a single value but a list attribute was chosen.

Select list element numbers (0 represents the first element)

igds_tag_names: 1

Result

Condition Parameter: igds_tag_names{1}

Tester Parameters

Transformer

Transformer Name: Tester

Test Description:

Pass Criteria

Pass Criteria: One Test (OR)

Composite Expression: <Unused>

Test Clauses

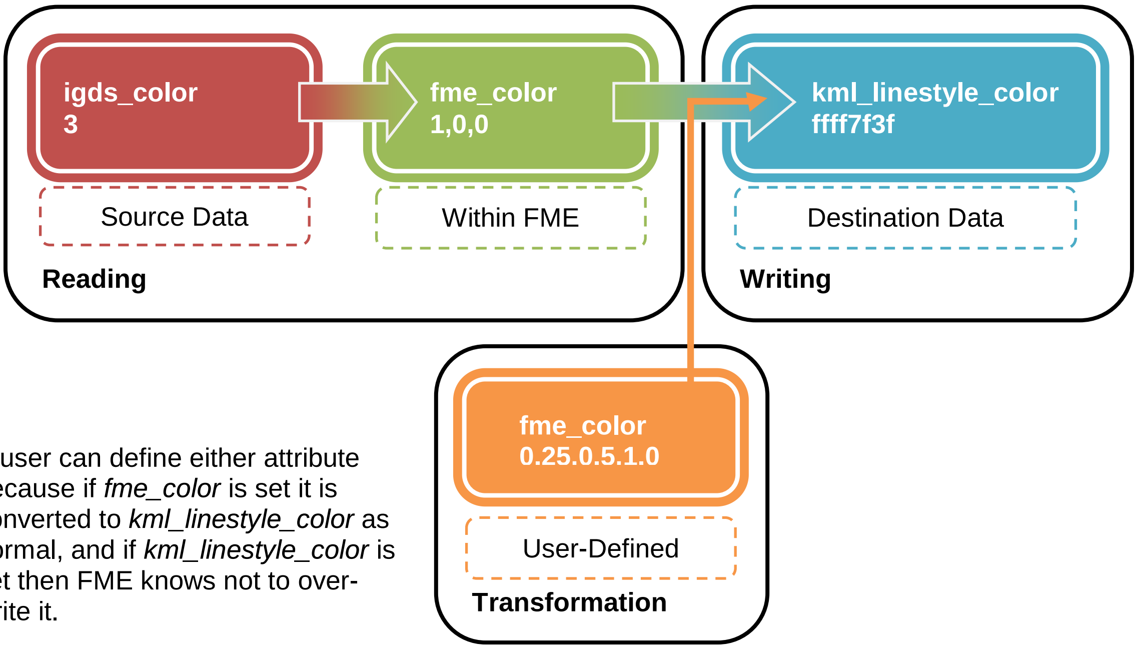
	Left Value	Operator	Right Value	Negate	Mode
1	igds_tag_names{1}	=		☐	Automatic

Transforming with Format Attributes

The other primary use of format attributes is to transform the data itself.

When writing data, FME attributes are turned into format attributes that reflect the data as it's supposed to be written. However, a user can override this process by predefining the value of these attributes before they are sent to the writer.

In other words, setting a format attribute may cause a transformation in the data to take place. Either the writer format attribute (here *kml_linestyle_color*) or the equivalent FME attribute (here *fme_color*) may be set to achieve the same end.



A user can define either attribute because if *fme_color* is set it is converted to *kml_linestyle_color* as normal, and if *kml_linestyle_color* is set then FME knows not to over-write it.

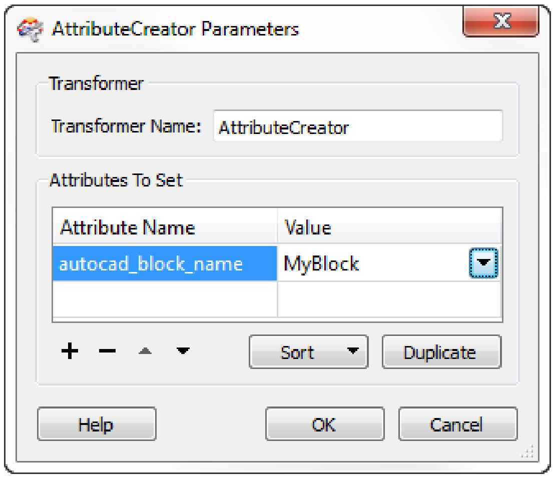
If a user manages to define both a format attribute and its FME equivalent, then the format attribute takes precedence and is used. For example, set *fme_color* **and** *kml_linestyle*_color, and the *kml* attribute gets priority.

This only really becomes a problem when reading and writing the same format, and the same format attributes exists on both reader and writer. In that case use the format attribute; it's not safe to use the FME equivalents.

Transformers for Setting Format Attributes

Format Attributes can actually be a little tricky to set.

Once a format attribute is exposed on a reader feature type, then an *AttributeCreator* transformer can be used to change its value. But this won't have any effect unless the translation is reading and writing from the same format.



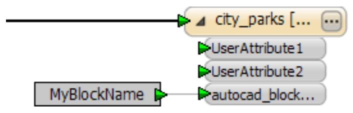
Transformer Name: AttributeCreator

Attributes To Set

Attribute Name	Value
autocad_block_name	MyBlock

On the other hand, exposing a format attribute on a writer feature type doesn't make that attribute available in the workspace in the same way (i.e. it isn't exposed back upstream).

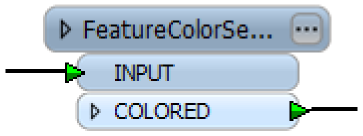
So, the most common method is to use the *AttributeCreator* transformer, but actually create the writer attribute and set it; for example create autocad_block_name and set a value for it.



The other common method is to use a constant, where format attributes exposed on a destination can be set by right-clicking the attribute and choosing 'Set to Constant Value'.

Used this way, the action is more like a Feature Type parameter; that is, it applies to all features written to that feature type.

Besides setting format attributes manually like this, there are a number of FME transformers that are designed to be merely a more user-friendly front end to setting a format attribute.

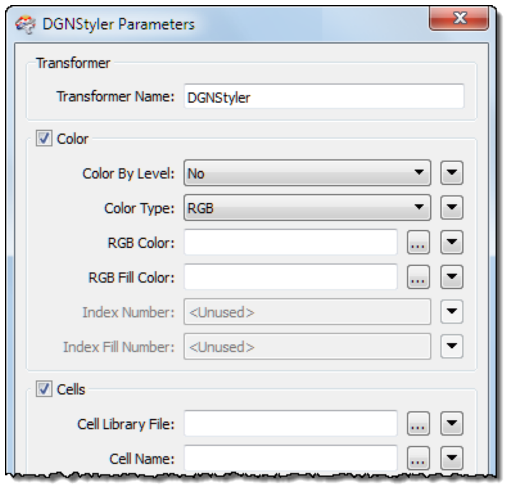


The *FeatureColorSetter* (for example) *"Assigns color to incoming features"*, but in reality all it does is set a new value for the format attributes fme_color, fme_fill_color, etc.

The DGNStyler helps a user to define the symbology of features to be written to a MicroStation Design File. It is really just a more pleasant way of using format attributes.

Similar transformers are:

- *DWGStyler*
- *KMLPropertySetter*
- *KMLStyler*
- *MapInfoStyler*
- *PDFStyler*



Transformer Name: DGNStyler

☑ Color

Color By Level: No
Color Type: RGB
RGB Color:
RGB Fill Color:
Index Number: <Unused>
Index Fill Number: <Unused>

☑ Cells

Cell Library File:
Cell Name:

Example 9: Calculate Statistical Information	
Scenario	FME user; City of Interopolis, Planning Department
Data	CSV format dataset of Cell Phone towers
Overall Goal	Create spatial data and extract information for use in Data Analytics
Demonstrates	Transformation, List Attributes, Best Practice
Starting Workspace	C:\FMEData\Workspaces\DAManual\Example9Begin.fmw
Finished Workspace	C:\FMEData\Workspaces\DAManual\Example9Complete.fmw

Now it's time to start processing the attributes to be analyzed. In this example, we will clean up the attributes, concatenate some values, and average others. Of course, we will use Format Attributes and Lists as part of this example, to demonstrate their use.

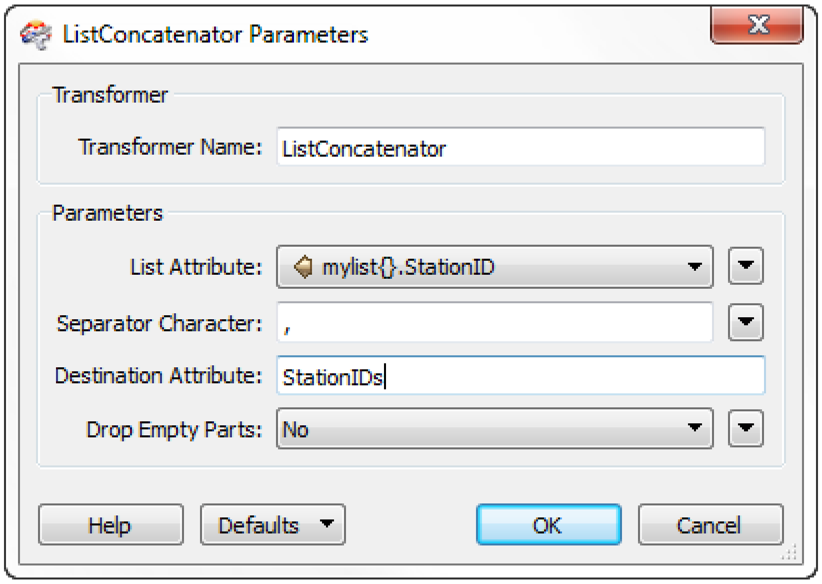
1) Start Workbench
Start Workbench (if necessary) and open the workspace from either Example 7 or Example 8. Alternatively you can open *C:\FMEData\Workspaces\DAManual\Example9Begin.fmw*

Turn off the Destination Redirect setting, if you still have it applied.

2) Concatenate Attributes
Firstly we'll create an attribute that concatenates all the Station IDs of points that overlapped with a particular grid square. We can do this with a transformer called the ListConcatenator.

Add a ListConcatenator transformer between the Tester PASSED output port and the writer Feature Type.

Open the parameters dialog. Select mylist{}.StationID as the List Attribute to concatenate.
Set a comma character (,) as the Separator Character.
Set the Destination Attribute as *StationIDs*


ListConcatenator Parameters

Transformer
Transformer Name: ListConcatenator

Parameters
List Attribute: mylist{}.StationID
Separator Character: ,
Destination Attribute: StationIDs
Drop Empty Parts: No

3) Concatenate Attributes - 2

Repeat step 2, but this time concatenate list{}.num_measures into an attribute called MeasureCount. **NB:** Ctrl+D is a good shortcut for duplicating the existing ListConcatenator.

4) Tidy Workspace

Now let's tidy up the workspace in accord with the principles of FME Best Practice.

FME Best Practice says that a good style of design makes it easier to navigate and understand an existing workspace, and thus simplifies the editing process; much the same way as a computer programmer adding comments to explain his actions

This is useful because workspaces are rarely static or used repeatedly without being edited; sooner or later the source or destination schema will change, or edits will be needed to take advantage of new or updated FME functionality.

At that point a clear layout will be invaluable!

Open a transformer's parameter dialogs and you will see that the name of the transformer can be changed. This allows it to be more descriptive of the actual task being carried out.

Open each ListConcatenator parameters dialog in turn. Rename them to:

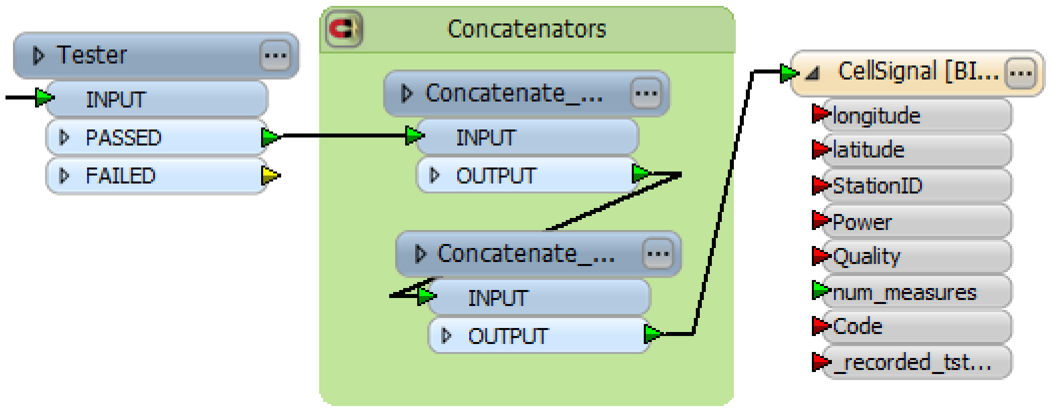
- Concatenate Station IDs
- Concatenate Measures

Now select both ListConcatenator transformers on the canvas simultaneously. Right-click them and choose the option to "Create Bookmark". A bookmark, like its real-world namesake, is a means of putting a marker down for easy access.

With FME the bookmark covers an area of workspace that is usually carrying out a specific task, so a user can pick it out of a larger set of transformers and move to it with relative ease.

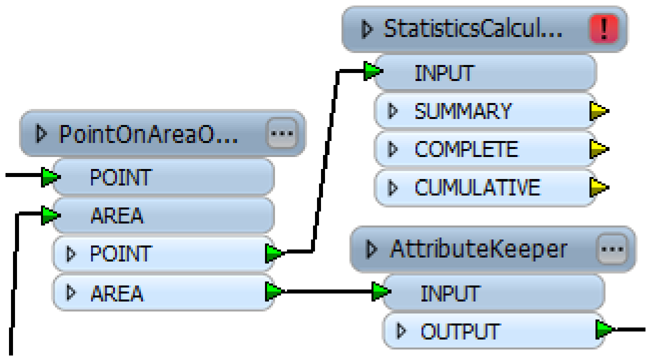
Set a name for the bookmark (e.g. Concatenators).

That part of the workspace will now look something like this:



5) Calculate Averages
To find the average power and quality for each grid square, it's easier to calculate this using the points themselves – so we aren't dealing with a list. As long as we have the grid ID attached to each point (the PointOnAreaOverlayer already gives us this) then there is no problem.

Place a StatisticsCalculator into the workspace. Attach it to the POINT output port on the PointOnAreaOverlayer transformer.



6) Set Parameters
Open the parameters dialog for the StatisticsCalculator.

For the Group-By parameter, select the attributes _column and _row
This will create a group-by, where each calculation is carried out uniquely for each grid square.

For the Attributes to Analyze parameter, select the attributes Power and Quality.

For the remaining parameters, removing the attribute name will stop that value being calculated. Because we don't need them, remove the attributes for:

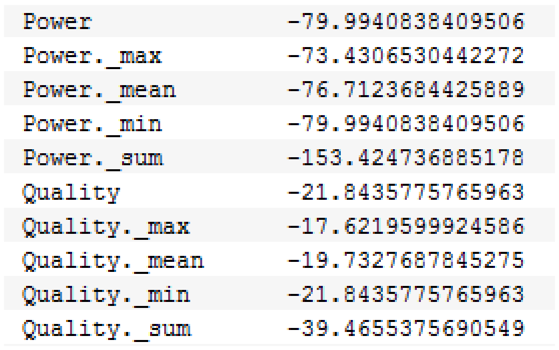
_median
_count
_numeric_count
_range
_stdev
_mode

Leave other parameters as they are. Click **OK** to close the dialog.

7) Run the Workspace
Connect an Inspector transformer to the StatisticsCalculator COMPLETE output port.
Save the workspace and then run it.

The output point features will display a set of statistics related to all points in that particular grid square.

If the max, mean, min and sum values are all equal, then don't worry. It just means you have selected a tower that is the only one in its grid!



Power	-79.9940838409506
Power._max	-73.4306530442272
Power._mean	-76.7123684425889
Power._min	-79.9940838409506
Power._sum	-153.424736885178
Quality	-21.8435775765963
Quality._max	-17.6219599924586
Quality._mean	-19.7327687845275
Quality._min	-21.8435775765963
Quality._sum	-39.4655375690549

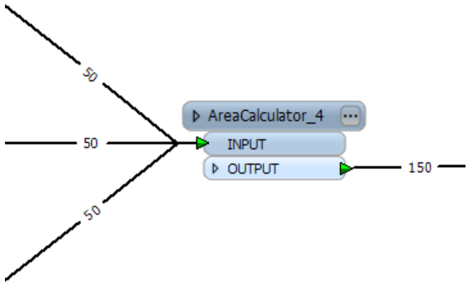
Data Merging

Data Merging

- FeatureMerger

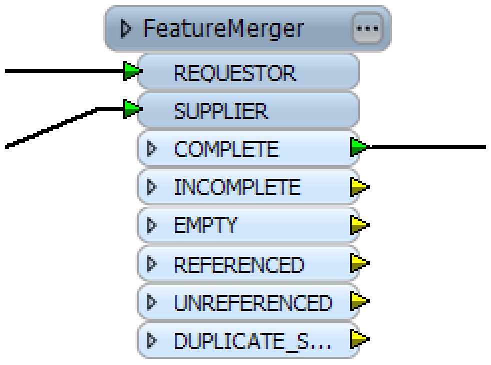
The ability to merge and join records is an important skill when using FME to handle spatial data.

In the Data Transformation chapter, we learned that when multiple streams are brought into the same input port no merging takes place. The data is simply accumulated into a single stream.



To carry out actual data merging requires a transformer called the FeatureMerger.

FeatureMerger
The FeatureMerger joins two streams of data together. The join occurs based on a common attribute value whose relationship is defined within the transformer parameters.



The FeatureMerger is for when both sets of data are being read in a workspace. It takes input into two ports - Requestor and Supplier - and merges information from each supplier onto the requestor with the same ID number.

The FeatureMerger is not the only transformer that can read and combine data together. Other transformers with a similar capability are the Joiner, the FeatureReader, the SQLExecutor, and the InlineQuerier.

For a comparison of these different transformers, see the FME Evangelist Article: http://evangelism.safe.com/fmeevangelist79/

Example 10: Merge Data Streams	
Scenario	FME user; City of Interopolis, Planning Department
Data	CSV format dataset of Cell Phone towers
Overall Goal	Create spatial data and extract information for use in Data Analytics
Demonstrates	Merging Data. Join Attributes.
Starting Workspace	C:\FMEData\Workspaces\DAManual\Example10Begin.fmw
Finished Workspace	C:\FMEData\Workspaces\DAManual\Example10Complete.fmw

The averages per grid square have been defined. Now it's time to merge that information onto the grid squares themselves. We'll do this with a FeatureMerger transformer.

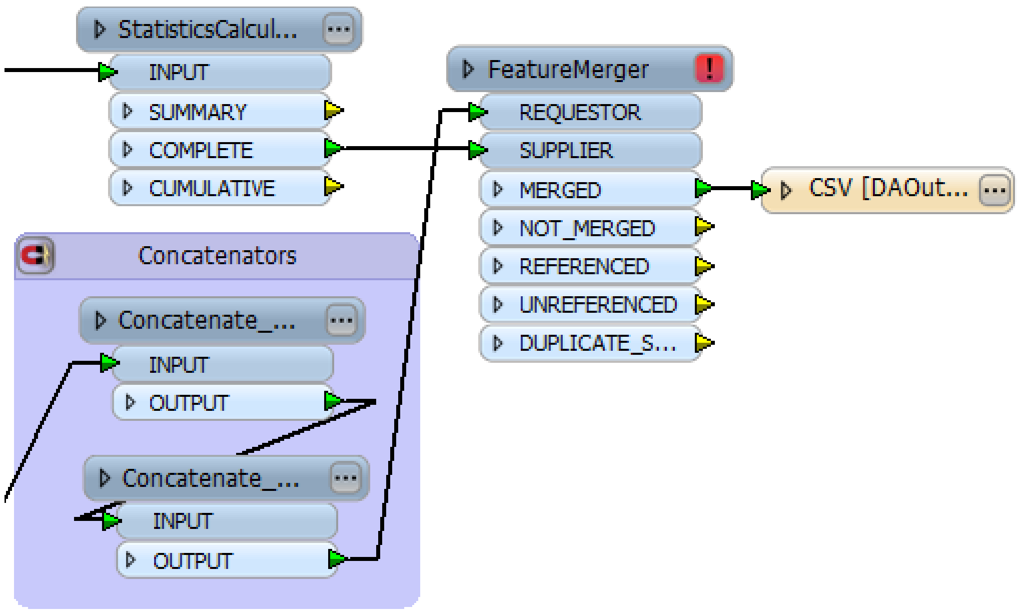
1) Start Workbench
Start Workbench (if necessary) and open the workspace from Example 9.
Alternatively you can open *C:\FMEData\Workspaces\DAManual\Example10Begin.fmw*

2) Merge Attributes
We can do a non-spatial (FeatureMerger) join this time because we have a common set of attributes; _row and _column, so add a FeatureMerger transformer to the workspace.

Connect the OUTPUT port from the second ListConcatenator to the REQUESTOR input port. These are the features that are requesting information.

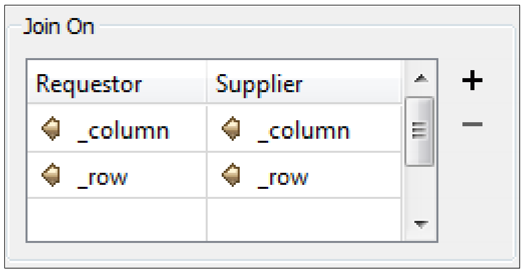
Connect the COMPLETE port from the StatisticsCalculator to the SUPPLIER input port. These are the features that will supply information.

The FeatureMerger MERGED output port should now be the one feeding the output Feature Type, like so:



3) Set FeatureMerger Parameters
Open the FeatureMerger parameters dialog.

Click Requestor > Set to Attribute Value > _column
Click Supplier > Set to Attribute Value > _column
Click Requestor > Set to Attribute Value > _row
Click Supplier > Set to Attribute Value > _row


Join On

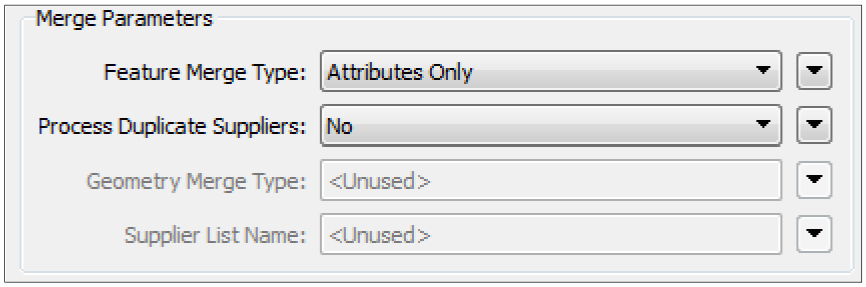
Requestor	Supplier
_column	_column
_row	_row

The ability to select multiple join attributes in a FeatureMerger is new to 2013-SP3.

The Feature Merge Type parameter should be set to Attributes Only.

Process Duplicate Suppliers should be set to No. In this case there will be duplicates (if there is more than one point per grid square) but they are all supplying the same attribute values, so duplicates can be ignored.

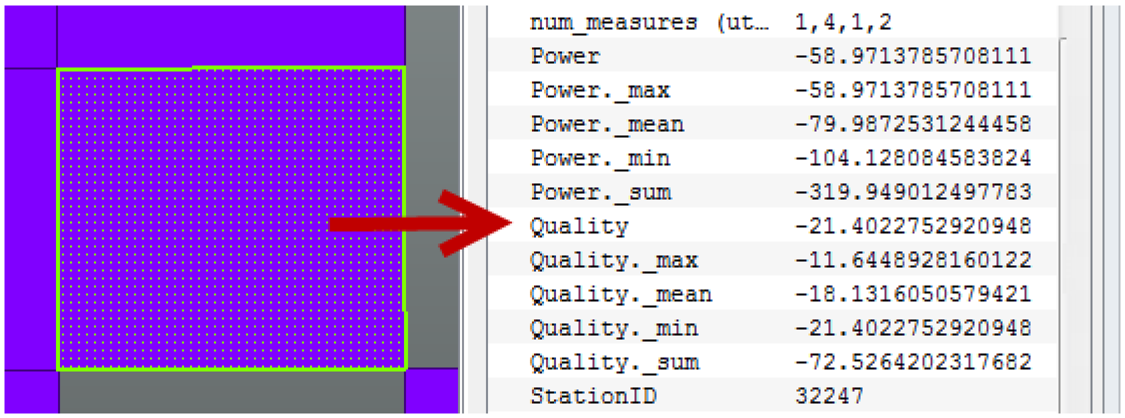
The Parameters part of this dialog will now look like this:


Merge Parameters

Feature Merge Type:	Attributes Only
Process Duplicate Suppliers:	No
Geometry Merge Type:	<Unused>
Supplier List Name:	<Unused>

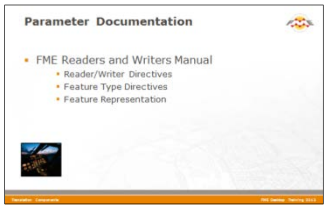
4) Run Workspace
Save and run the workspace. Be sure to direct the output to the Data Inspector, as the writer Feature Type is not yet set up to record these results.

Each grid square will not have a set of statistics relating to the point features within it:



```
num_measures (ut…   1,4,1,2
Power               -58.9713785708111
Power._max          -58.9713785708111
Power._mean         -79.9872531244458
Power._min          -104.128084583824
Power._sum          -319.949012497783
Quality             -21.4022752920948
Quality._max        -11.6448928160122
Quality._mean       -18.1316050579421
Quality._min        -21.4022752920948
Quality._sum        -72.5264202317682
StationID           32247
```

Parameter Documentation

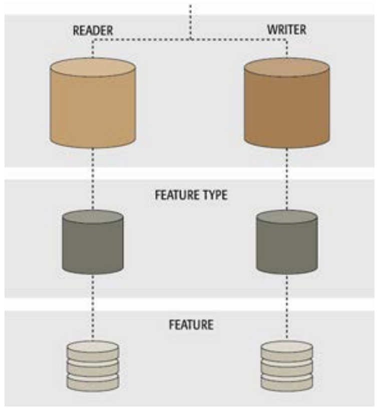


Parameter Documentation

- FME Readers and Writers Manual
  - Reader/Writer Directives
  - Feature Type Directives
  - Feature Representation

The FME Readers and Writers Reference Manual documents all of the parameters available for each format, from the reader and writer level down to format attributes for controlling features.

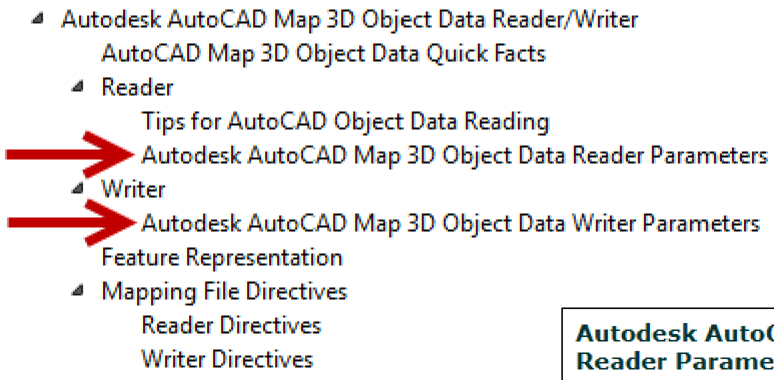
FME Readers and Writers Reference Manual
The FME Readers and Writers Reference Manual is part of the help system included with FME Workbench. It is where the parameters for each level of the translation hierarchy are documented.



This manual lists – format by format – what parameters exist for the reader, writer, feature types and features.

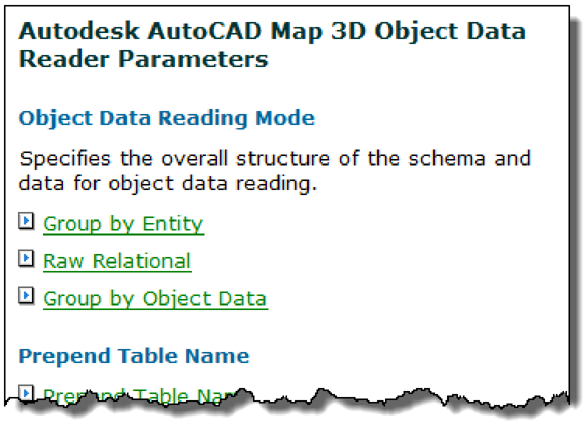
Importantly, each parameter includes a description of what it does, and in some cases what values are acceptable.

Reader/Writer Parameters
Taking the format Autodesk AutoCAD Map 3D Object Data as an example, the Reader and Writer parameters are listed under the Reader and Writer sections.



- Autodesk AutoCAD Map 3D Object Data Reader/Writer
  - AutoCAD Map 3D Object Data Quick Facts
  - Reader
    - Tips for AutoCAD Object Data Reading
    - Autodesk AutoCAD Map 3D Object Data Reader Parameters
  - Writer
    - Autodesk AutoCAD Map 3D Object Data Writer Parameters
  - Feature Representation
  - Mapping File Directives
    - Reader Directives
    - Writer Directives

For example, there the different values for the Object Data Reading Mode parameter are listed and explained.



Autodesk AutoCAD Map 3D Object Data Reader Parameters

Object Data Reading Mode

Specifies the overall structure of the schema and data for object data reading.

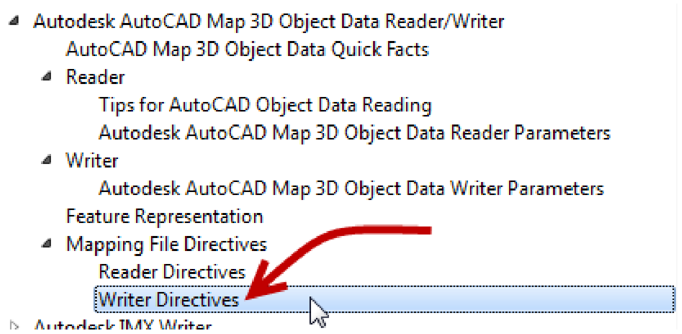
- Group by Entity
- Raw Relational
- Group by Object Data

Prepend Table Name

- Prepend Table Na

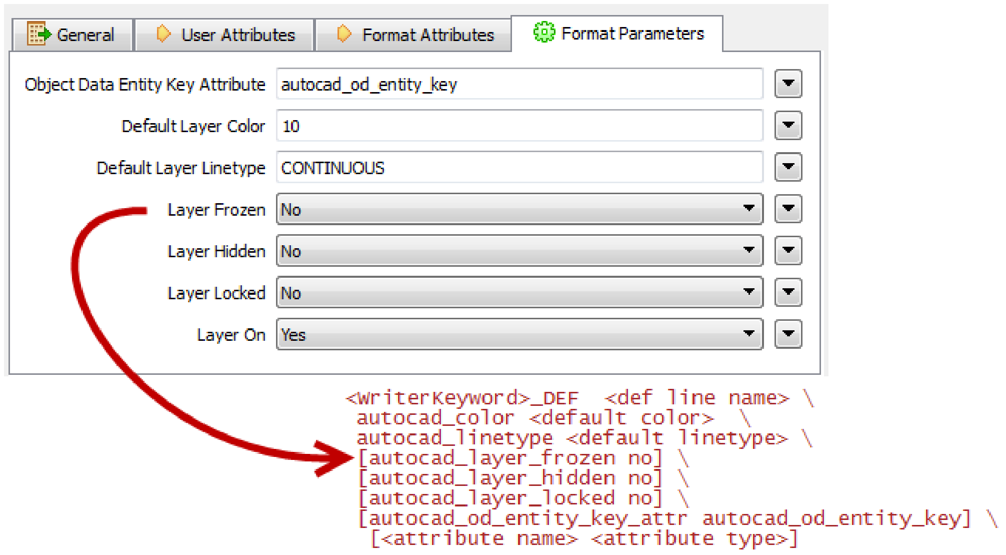
Feature Type Parameters

Feature Type Parameters are (for the moment) listed under a Mapping File directive called DEF



- Autodesk AutoCAD Map 3D Object Data Reader/Writer
  - AutoCAD Map 3D Object Data Quick Facts
  - Reader
    - Tips for AutoCAD Object Data Reading
    - Autodesk AutoCAD Map 3D Object Data Reader Parameters
  - Writer
    - Autodesk AutoCAD Map 3D Object Data Writer Parameters
  - Feature Representation
  - Mapping File Directives
    - Reader Directives
    - Writer Directives
- Autodesk IMX Writer

For example, here the Feature Type parameter *Layer Frozen* is documented:

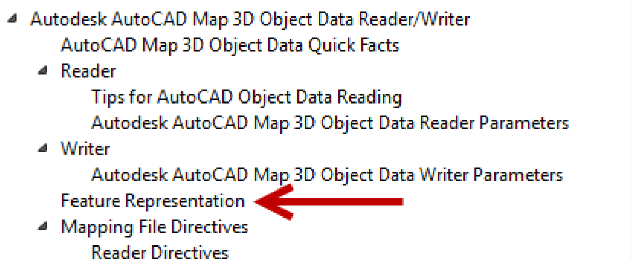


Object Data Entity Key Attribute	autocad_od_entity_key
Default Layer Color	10
Default Layer Linetype	CONTINUOUS
Layer Frozen	No
Layer Hidden	No
Layer Locked	No
Layer On	Yes

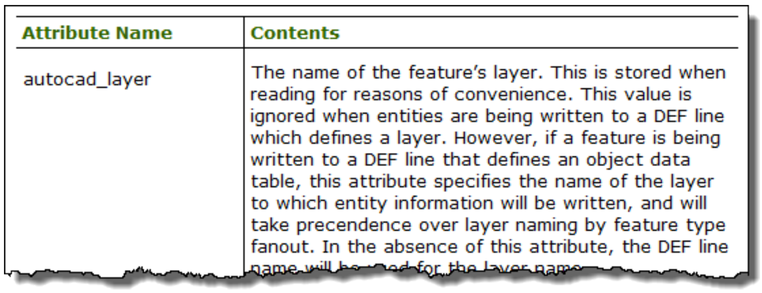
```
<WriterKeyword>_DEF  <def line name> \
 autocad_color <default color>  \
 autocad_linetype <default linetype> \
 [autocad_layer_frozen no] \
 [autocad_layer_hidden no] \
 [autocad_layer_locked no] \
 [autocad_od_entity_key_attr autocad_od_entity_key] \
  [<attribute name> <attribute type>]
```

Format Attributes

Format Attributes are documented under a section called Feature Representation:



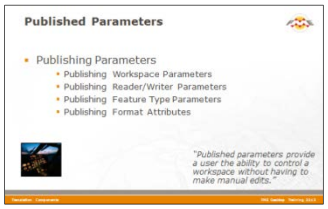
- Autodesk AutoCAD Map 3D Object Data Reader/Writer
  - AutoCAD Map 3D Object Data Quick Facts
  - Reader
    - Tips for AutoCAD Object Data Reading
    - Autodesk AutoCAD Map 3D Object Data Reader Parameters
  - Writer
    - Autodesk AutoCAD Map 3D Object Data Writer Parameters
  - Feature Representation
  - Mapping File Directives
    - Reader Directives



Attribute Name	Contents
autocad_layer	The name of the feature's layer. This is stored when reading for reasons of convenience. This value is ignored when entities are being written to a DEF line which defines a layer. However, if a feature is being written to a DEF line that defines an object data table, this attribute specifies the name of the layer to which entity information will be written, and will take precendence over layer naming by feature type fanout. In the absence of this attribute, the DEF line name will be used for the layer name.

For example, here is documented the AutoCAD Map 3D Format Attribute called autocad_layer:

Published Parameters



Published Parameters

- Publishing Parameters
  - Publishing Workspace Parameters
  - Publishing Reader/Writer Parameters
  - Publishing Feature Type Parameters
  - Publishing Format Attributes

"Published parameters provide a user the ability to control a workspace without having to make manual edits."

Publishing parameters is a method by which FME prompts to change read and write control parameters at runtime.

As shown, each different level of translation hierarchy has a related set of control parameters.

However, there are two potential users of FME; a workspace author and the end-user.

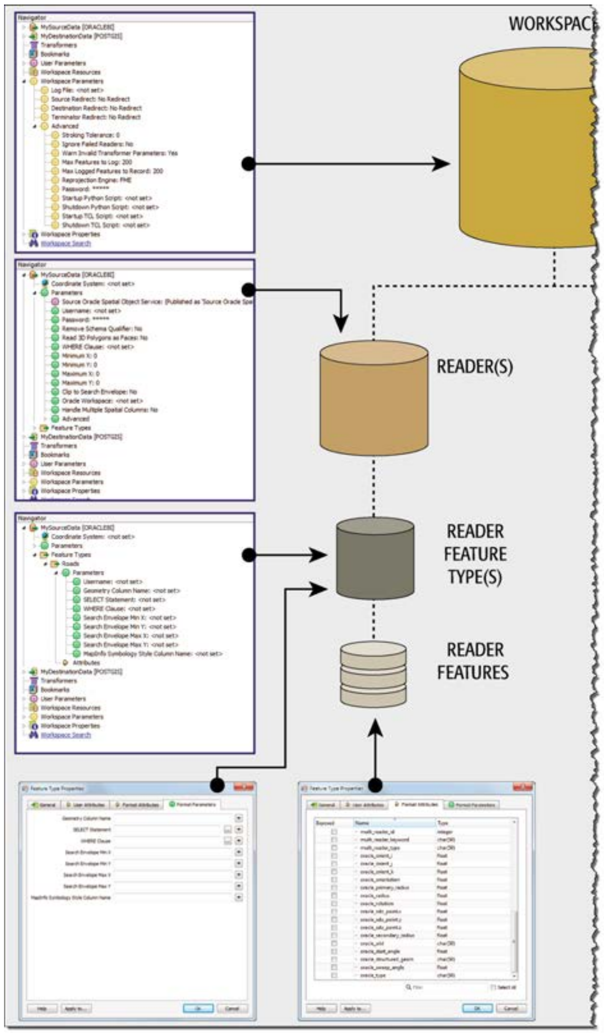
Ideally, if the end-user wanted to change one or more of these parameters, they should not need to edit the workspace in the same way that an author would.

Published Parameters provide this functionality.

Publishing parameters is a way to prompt the end user to enter a value, in much the same way that FME will prompt for any undefined mandatory parameters.

Prompting the user for values thus avoids the need to make manual edits in the workspace.

Any setting that can be defined through the Navigator window is capable of being set as a published parameter. This includes most workspace parameters, all reader and writer parameters, and all feature type parameters.



```
Navigator
MySourceData [ORACLE8I]
MyDestinationData [POSTGIS]
Transformers
Bookmarks
User Parameters
Workspace Resources
Workspace Parameters
    Log File: <not set>
    Source Redirect: No Redirect
    Destination Redirect: No Redirect
    Terminator Redirect: No Redirect
    Advanced
        Stroking Tolerance: 0
        Ignore Failed Readers: No
        Warn Invalid Transformer Parameters: Yes
        Max Features to Log: 200
        Max Logged Features to Record: 200
        Reprojection Engine: FME
        Password: *****
        Startup Python Script: <not set>
        Shutdown Python Script: <not set>
        Startup TCL Script: <not set>
        Shutdown TCL Script: <not set>
Workspace Properties
Workspace Search
```

```
Navigator
MySourceData [ORACLE8I]
    Coordinate System: <not set>
    Parameters
        Source Oracle Spatial Object Service: [Published as 'Source Oracle Spa
        Username: <not set>
        Password: *****
        Remove Schema Qualifier: No
        Read 3D Polygons as Faces: No
        WHERE Clause: <not set>
        Minimum X: 0
        Minimum Y: 0
        Maximum X: 0
        Maximum Y: 0
        Clip to Search Envelope: No
        Oracle Workspace: <not set>
        Handle Multiple Spatial Columns: No
        Advanced
    Feature Types
MyDestinationData [POSTGIS]
Transformers
Bookmarks
User Parameters
Workspace Resources
Workspace Parameters
Workspace Properties
```

```
Navigator
MySourceData [ORACLE8I]
    Coordinate System: <not set>
    Parameters
    Feature Types
        Roads
            Parameters
                Username: <not set>
                Geometry Column Name: <not set>
                SELECT Statement: <not set>
                WHERE Clause: <not set>
                Search Envelope Min X: <not set>
                Search Envelope Min Y: <not set>
                Search Envelope Max X: <not set>
                Search Envelope Max Y: <not set>
                MapInfo Symbology Style Column Name: <not set>
            Attributes
MyDestinationData [POSTGIS]
Transformers
Bookmarks
User Parameters
Workspace Resources
Workspace Parameters
Workspace Properties
Workspace Search
```

Chef Bimm says…

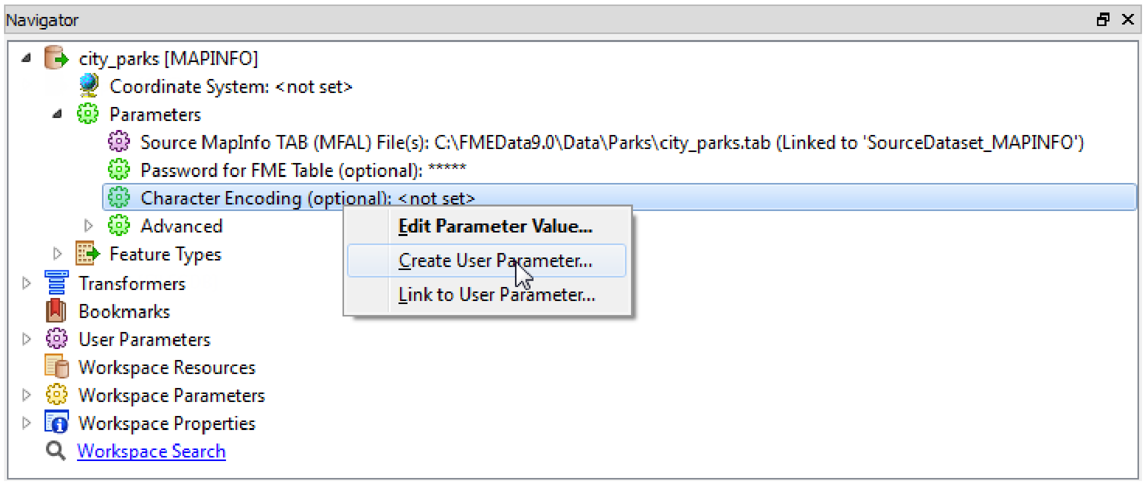
"Think of Published Parameters as your coffee options printed on the side of a paper cup.

They are a way for a customer to have their wishes defined without setting the machine themself".

Publishing Parameters

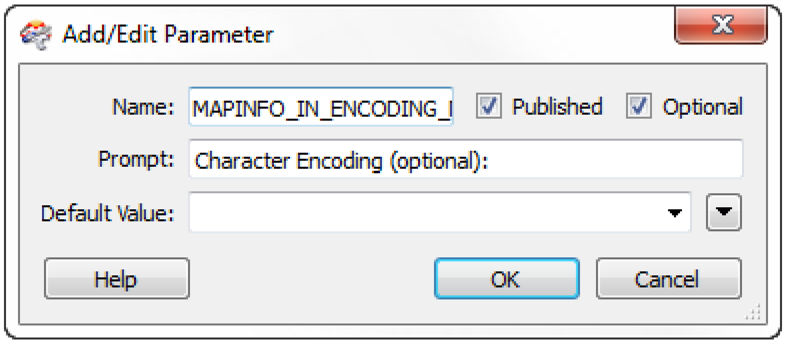
To publish a parameter, simply locate it in the Navigator window, right-click it, and choose the **Create User Parameter** option. This opens a dialog for defining the publishing settings.

Here the user is choosing to publish a reader parameter that sets what character encoding the source data is in. The purple color of the Source Dataset parameter shows that this has already been published.


Navigator
- city_parks [MAPINFO]
  - Coordinate System: <not set>
  - Parameters
    - Source MapInfo TAB (MFAL) File(s): C:\FMEData9.0\Data\Parks\city_parks.tab (Linked to 'SourceDataset_MAPINFO')
    - Password for FME Table (optional): *****
    - Character Encoding (optional): <not set>
    - Advanced
  - Feature Types
- Transformers
- Bookmarks
- User Parameters
- Workspace Resources
- Workspace Parameters
- Workspace Properties
- Workspace Search

Notice how the parameter definition includes:

- Parameter name
- Parameter prompt
- Default value
- Optional Flag
- Published Flag


Add/Edit Parameter

Name: MAPINFO_IN_ENCODING_I [✓] Published [✓] Optional

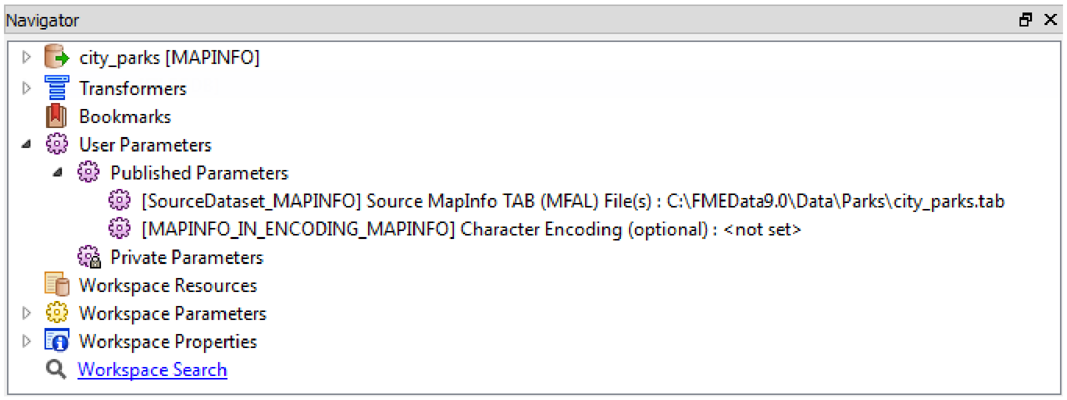
Prompt: Character Encoding (optional):

Default Value:

The 'published' flag exists because there are two different parameter states: public and private.

- Public means the parameter is published for an end-user to set.
- Private means it can only be used inside the workspace, but shareable in several places.

For ease of editing, all published parameters also appear in a separate section of the Navigator.

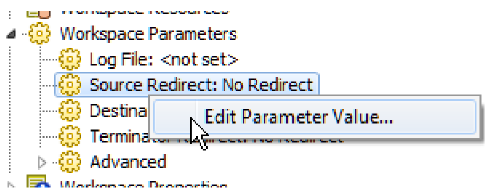

Navigator
- city_parks [MAPINFO]
- Transformers
- Bookmarks
- User Parameters
  - Published Parameters
    - [SourceDataset_MAPINFO] Source MapInfo TAB (MFAL) File(s) : C:\FMEData9.0\Data\Parks\city_parks.tab
    - [MAPINFO_IN_ENCODING_MAPINFO] Character Encoding (optional) : <not set>
  - Private Parameters
- Workspace Resources
- Workspace Parameters
- Workspace Properties
- Workspace Search

Publishing Workspace Parameters

To publish a workspace parameter simply locate the parameter in the Navigator, right-click, and choose Create User Parameter.

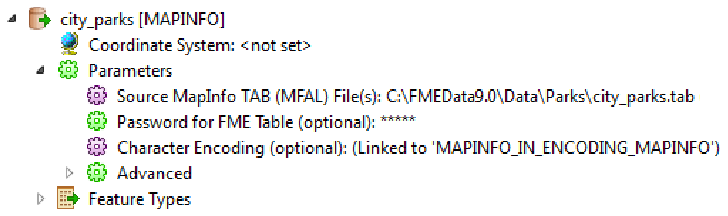
The limitation here is that many basic parameters (such as Destination Redirect or Workspace Password) can't be published because it doesn't make sense to do so.

In such cases that option is simply left off the menu:



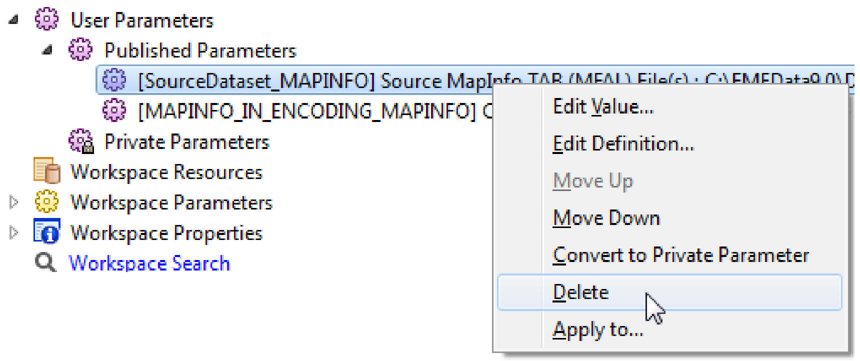
Publishing Reader/Writer Parameters

Publishing Reader and Writer parameters is the most common use of this functionality. It is achieved by using the same right-click context menu in the Navigator window.


city_parks [MAPINFO]
Coordinate System: <not set>
Parameters
Source MapInfo TAB (MFAL) File(s): C:\FMEData9.0\Data\Parks\city_parks.tab
Password for FME Table (optional): *****
Character Encoding (optional): (Linked to 'MAPINFO_IN_ENCODING_MAPINFO')
Advanced
Feature Types

Notice that some parameters are automatically published by FME. That's because these are common parameters the user will often need to set; for example reader input file and writer output file locations.

If it's not appropriate for a user to select these, then the published parameters can be simply removed.



Publishing Feature Type Parameters

For Feature Type parameters, it's important to notice that these can only be published in the Navigator window. There are NO right-click > publish options in the Feature Type Properties dialog.

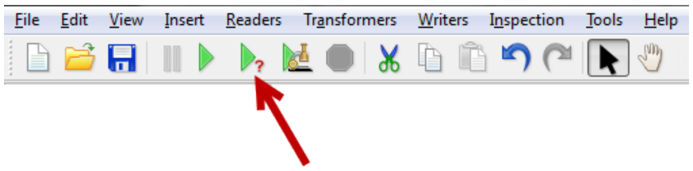
First-Officer Transformer says…

'Besides translation components for reading and writing, you can also publish parameters for transformers; again by locating the parameter to be published in the Navigator window, right-clicking, and choosing Create User Parameter.'

Using Published Parameters

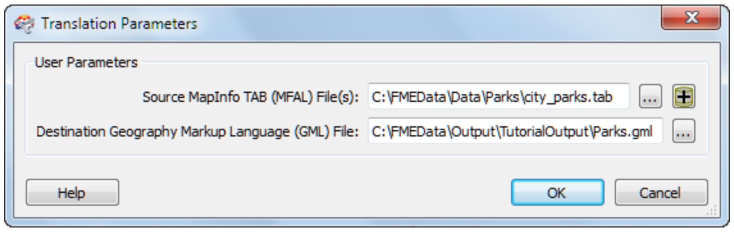
Published parameters are activated whenever a workspace is run using the option ***File*** > ***Prompt and Run Translation*** from the menu bar in FME Workbench.

The shortcut for this command is *Ctrl+R* and there is a related Prompt and Run button on the toolbar.



Note: *The simpler File > Run (shortcut F5) will not prompt for values, but re-use existing ones.*

When a workspace is run in prompt mode, the user receives a dialog prompting them to enter new values.



Source MapInfo TAB (MFAL) File(s): C:\FMEData\Data\Parks\city_parks.tab

Destination Geography Markup Language (GML) File: C:\FMEData\Output\TutorialOutput\Parks.gml

Running a workspace in the FME Quick Translator always prompts for parameters; which is why it's so suitable for non-FME-authoring end-users to run a workspace.

Published Parameters on the Command Line

In the same way that FME translations can be run from the command line, they can be passed values to published parameters on the command line using the syntax:

```
--<Parameter Name> <Parameter Value>
```

Notice that the parameter name matches that supplied in the published parameter definition.

```
Windows command-line to run this workspace:

fme.exe Ex5-StructuralTransformation-begin.fmw
      --SourceDataset_MAPINFO C:\FMEData\Data\Parks\city_parks.tab
      --DestDataset_GML C:\FMEData\Output\TutorialOutput\Parks.gml
```

As usual, the log window reveals the command line used in the above translation.

The command line in the Log window specifically states 'Windows command-line'.

The biggest difference between Windows and UNIX shells is how parameters with spaces in them are quoted.

Example 11: Allow User Control	
Scenario	FME user; City of Interopolis, Planning Department
Data	CSV format dataset of Cell Phone towers
Overall Goal	Create spatial data and extract information for use in Data Analytics
Demonstrates	Published Parameters
Starting Workspace	C:\FMEData\Workspaces\DAManual\Example11Begin.fmw
Finished Workspace	C:\FMEData\Workspaces\DAManual\Example11Complete.fmw

Published Parameters will let us give the end user control over how the translation works.

1) Start Workbench

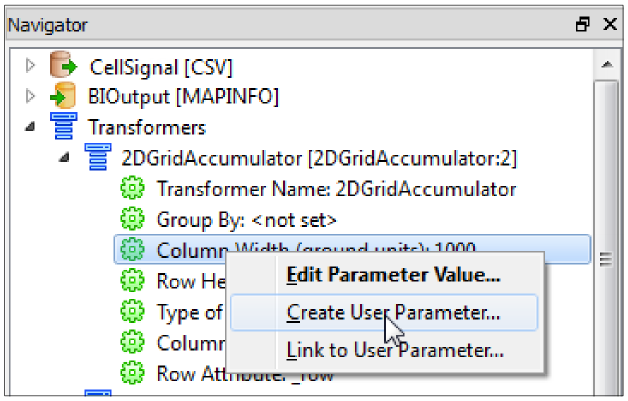
Start Workbench (if necessary) and open the workspace from Example 10.
Alternatively you can open *C:\FMEData\Workspaces\DAManual\Example11Begin.fmw*

2) Publish Parameter

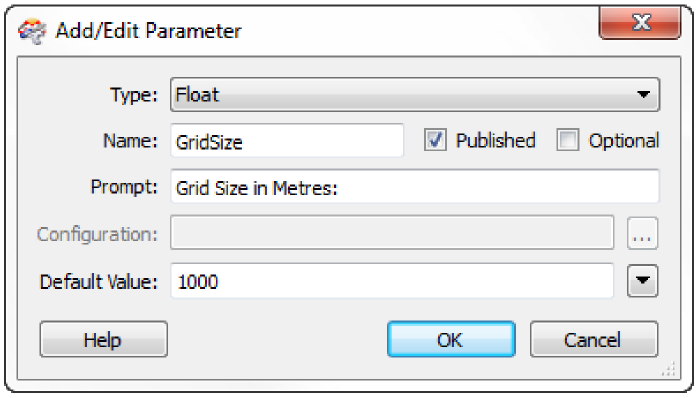
One thing we want to do is let the user specify the size of the grid squares used to aggregate the point data. This can be done with a Published Parameter.

In the Navigator window browse to the 2DGridAccumulator transformer and expand its list of parameters.

Right click on 'Column Width', and select 'Create user parameter'.



When prompted, set up the following parameters:



Type: Float
Name: GridSize ☑ Published ☐ Optional
Prompt: Grid Size in Metres:
Configuration:
Default Value: 1000

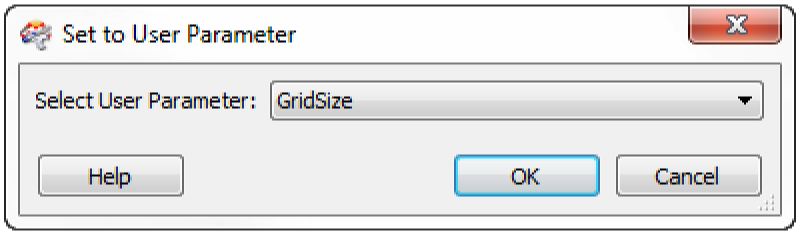
Type = float
Name = GridSize
Published = yes
Optional = no
Prompt = Grid size in meters
Default value = 1000

3) Link Parameter

Because we only want square grid sizes, Row Height can share the same published parameter as Column Width; otherwise they would need one each and the user have to enter the same information twice.

So, right click on Row Height, and select “Link to user parameter”.

When prompted, and select “GridSize” as the user parameter to link to.



Set to User Parameter

Select User Parameter: GridSize

4) Publish Parameter – 2

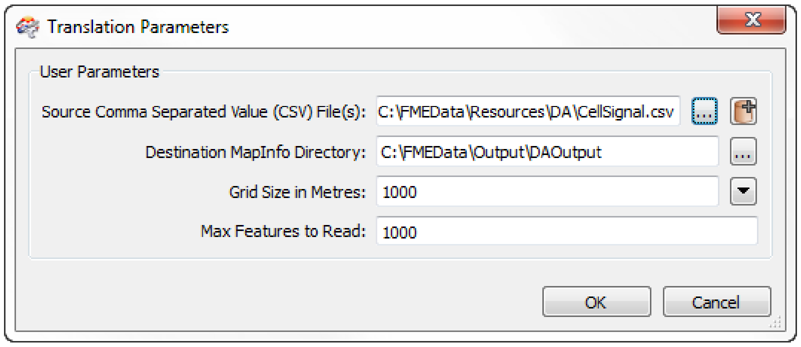
The user may also want to select how many lines (features) are read from the CSV file.

Again in the Navigator, locate the CSV reader “Max Features to Read” parameter, right-click it, and then select ‘Create user parameter’. The default values will work.

5) Run the Translation

Save the translation. This time run it using the Prompt and Run Button (or File > Prompt and Run from the menu bar, or the shortcut key Ctrl+R).

Experiment using different values for each of the two new published parameters.



Translation Parameters

User Parameters

Source Comma Separated Value (CSV) File(s): C:\FMEData\Resources\DA\CellSignal.csv

Destination MapInfo Directory: C:\FMEData\Output\DAOutput

Grid Size in Metres: 1000

Max Features to Read: 1000

6) Advanced Task

As a couple of advanced tasks:

- Remove the existing published parameters for Source CSV File and Destination MapInfo Directory. We don’t want the end user to be setting these.
- Edit the definitions of the two published parameters you just created. Is there a better parameter type you could use instead of Float and Integer? Would a drop-down list (Choice) work? Or maybe a Slider type would be useful?

Conditional Actions

Conditional Actions are where the behaviour of an FME transformer is dictated by the result of a test or condition.

Conditions can be described as IF THIS, THEN THAT, sometimes with an ELSE tacked on.

For example, IF you've attended this FME training course, THEN you'll know there is a section on Conditions, ELSE you will be unaware of how useful Conditions are!

The majority of cases are either for Filtering or for Mapping.

Conditional Filtering
Filtering (or Branching) uses conditions to subdivide data as it flows through a workspace. An analogy is: IF you are a BUS, THEN follow this road, ELSE, IF you are a CAR, THEN follow this road, ELSE, IF you are a TRUCK, THEN follow this road.

In FME the GeometryFilter transformer is a good example. It has multiple output ports, each of which carries data off in a different direction. Check out the Filters category of the Transformer Gallery for more examples.

In the GeometryFilter the conditions for dividing data are defined by FME. But in other transformers the decision about which features are output to which port is decided by a user-defined test. The Tester transformer, among many others, is the prime example of this.

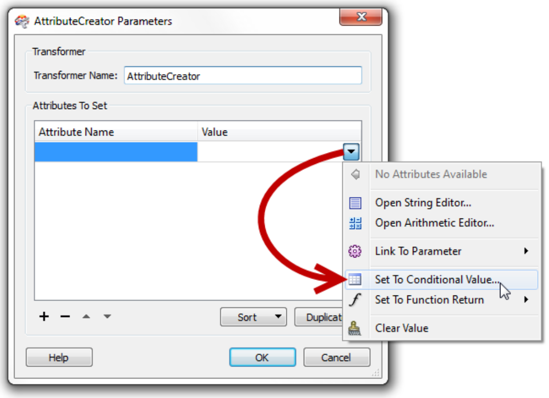
Conditional Mapping
Attribute Mapping is another common use for conditions in FME. Data doesn't get divided but instead an attribute is set to define the result.

To use the same analogy: IF you are a BUS, THEN you get a red sticker, ELSE, IF you are a CAR, THEN you get an orange sticker, ELSE, IF you are a TRUCK, THEN you get a green sticker.

Conditional Mapping is - like conditional filtering - where the user defines the tests and conditions for the mapping to occur. Again there are many transformers that can do this.

Although we use the term "mapping", virtually any transformer in FME that creates an attribute will let you do so conditionally. The prime example is the AttributeCreator.

Conditions are set in transformers on the drop-down menu for attribute values:


AttributeCreator Parameters

Transformer

Transformer Name: AttributeCreator

Attributes To Set

Attribute Name	Value

Example 12: Handle Unit Choices and Clean Up Workspace	
Scenario	FME user; City of Interopolis, Planning Department
Data	CSV format dataset of Cell Phone towers
Overall Goal	Create spatial data and extract information for use in Data Analytics
Demonstrates	Conditional Processing, Published Parameters, Schema Editing, Data Styling
Starting Workspace	C:\FMEData\Workspaces\DAManual\Example12Begin.fmw
Finished Workspace	C:\FMEData\Workspaces\DAManual\Example12Complete.fmw

One other published parameter we could create is the ability to decide whether grid size is to be provided in feet or metres. But this sets up a condition that the 2DGridAggregator must handle.

1) Start Workbench
Start Workbench (if necessary) and open the workspace from Example 11.
Alternatively you can open *C:\FMEData\Workspaces\DAManual\Example12Begin.fmw*

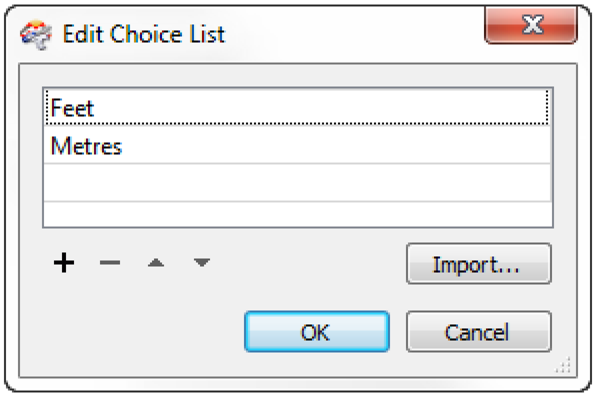
2) Create Published Parameter
In the Navigator window, locate the list of User Parameters. Right-click on the User Parameters heading and choose the option Add Parameter.

Define a new parameter as follows:

Type:	Choice
Name:	GridUnits
Published:	Yes
Optional:	No
Prompt:	Units for Grid Size

For Configuration, click the […] button to open the configuration dialog. Create two choices: Feet and Metres.

Click **OK** to accept the list, then again to create the new Parameter.

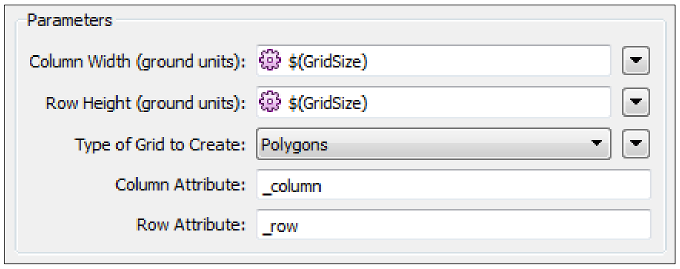


3) Organize Parameters
In the list of Published Parameters, delete the ones for Source and Destination datasets (if you haven't already). Reorganize the order of the remaining parameters (you can use a drag-and-drop action) to be:

- GridSize
- GridUnits
- MAX_FEATURES

Edit the prompt for the GridSize parameter to remove the "in Metres" part. The user now has a choice.

4) Setup 2DGridAccumulator
Now open the parameters dialog for the 2DGridAccumulator transformer. It will have changed its appearance because two of the parameters have been published, and will now look like this.

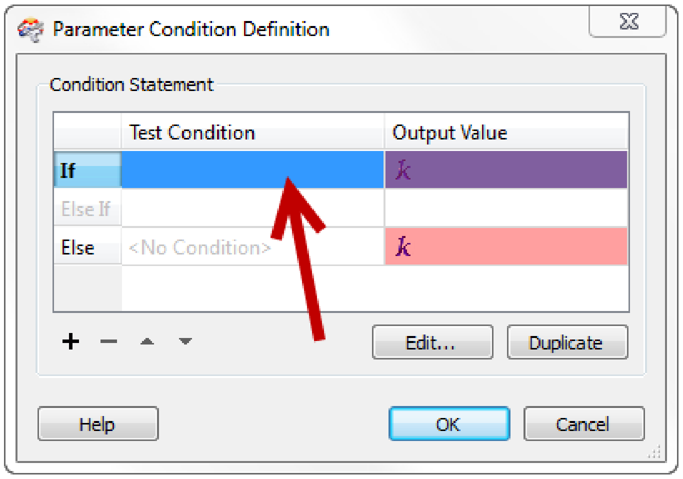


Parameters

Column Width (ground units):	$(GridSize)
Row Height (ground units):	$(GridSize)
Type of Grid to Create:	Polygons
Column Attribute:	_column
Row Attribute:	_row

Click the drop-down arrow for the Column Width parameter, and choose the option Set to Conditional Value.

In the Parameter Condition Definition dialog, double-click in the first Test Condition Field:

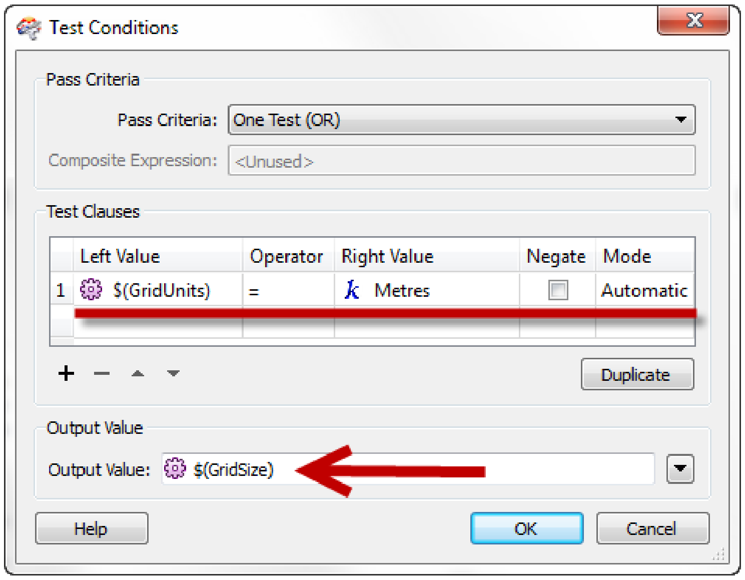


Parameter Condition Definition

Condition Statement

	Test Condition	Output Value
If		
Else If		
Else	<No Condition>	

This now opens up a test dialog, very similar to the Tester transformer or Data Inspector filter tool.



Test Conditions

Pass Criteria

Pass Criteria: One Test (OR)

Composite Expression: <Unused>

Test Clauses

	Left Value	Operator	Right Value	Negate	Mode
1	$(GridUnits)	=	Metres	☐	Automatic

Output Value

Output Value: $(GridSize)

For the Left Value select Parameter > GridUnits, for the operator choose Equals (=).

For the Right Value manually type in the word Metres.

In the Output Value field (at the foot of the dialog) select Link to Parameter > GridSize

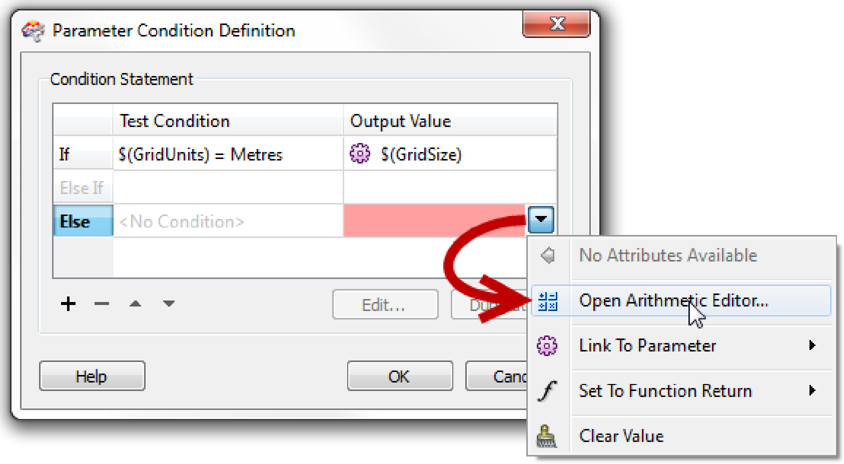
Essentially this mapping says, IF the chosen units=Metres, THEN grid size remains unchanged.

Click OK to close this dialog.

Back in the Parameter Condition Definition dialog, we can now just set up an ELSE action. There's no need to do another test because if the chosen units aren't metres, then they must be feet.

So, double-click in the Else Output Value field and from the drop-down list select Open Arithmetic Editor.

The transformer expects metres, so if the user is entering feet we need to do a calculation to correct it.

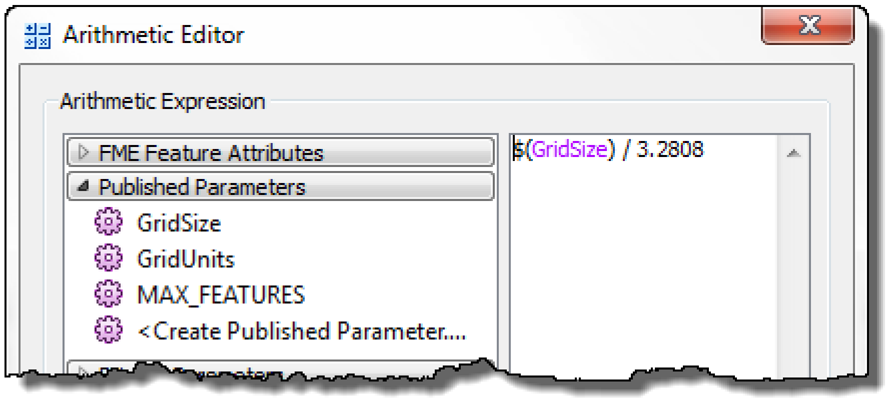

Parameter Condition Definition

Condition Statement

	Test Condition	Output Value
If	$(GridUnits) = Metres	$(GridSize)
Else If		
Else	<No Condition>	

In the arithmetic editor, expand the list of Published Parameters and double-click on GridSize to add it to the arithmetic expression. Then manually type in: /3.2808

This sets up the expression to be $(GridSize) / 3.2808


Arithmetic Editor

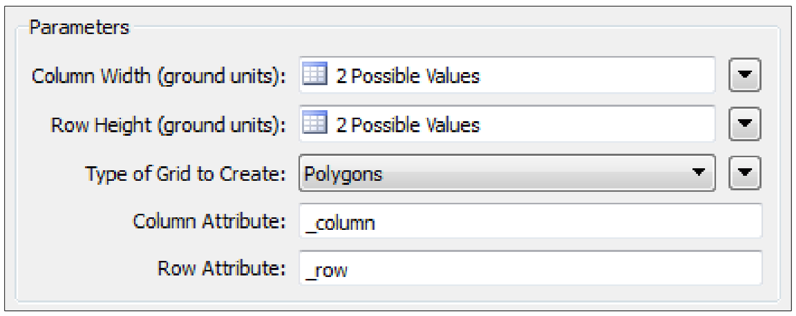
Arithmetic Expression

$(GridSize) / 3.2808

3.2808 is the number of feet in a metre. The result will be the user's feet value, converted into metres, which is the units used in the dynamic Coordinate System. Now the user can enter their grid size in feet or metres and have it work correctly.

Click **OK**, then once more to return to the main 2DGridAccumulator parameter dialog.

Then repeat this step for the Row Height parameter, after which the dialog will look like this:


Parameters

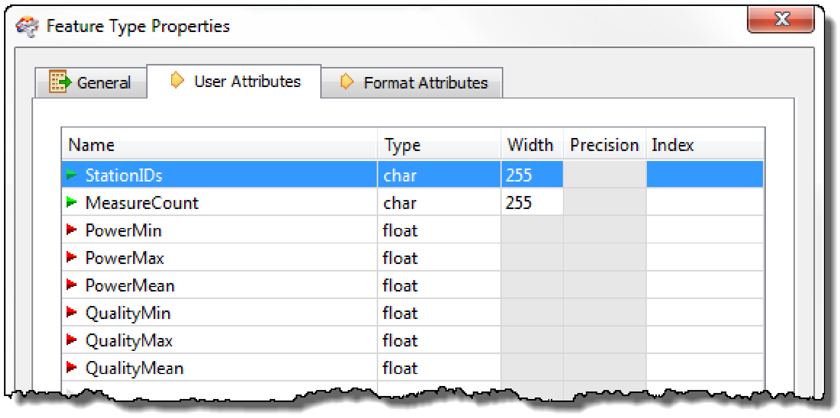
Column Width (ground units):	2 Possible Values
Row Height (ground units):	2 Possible Values
Type of Grid to Create:	Polygons
Column Attribute:	_column
Row Attribute:	_row

Click **OK** to close it.

5) Clean Up Schema
There's just one last task to do before we can run the workspace for real: clean up the output schema. At the moment it has none of the attributes defined to store the required output.

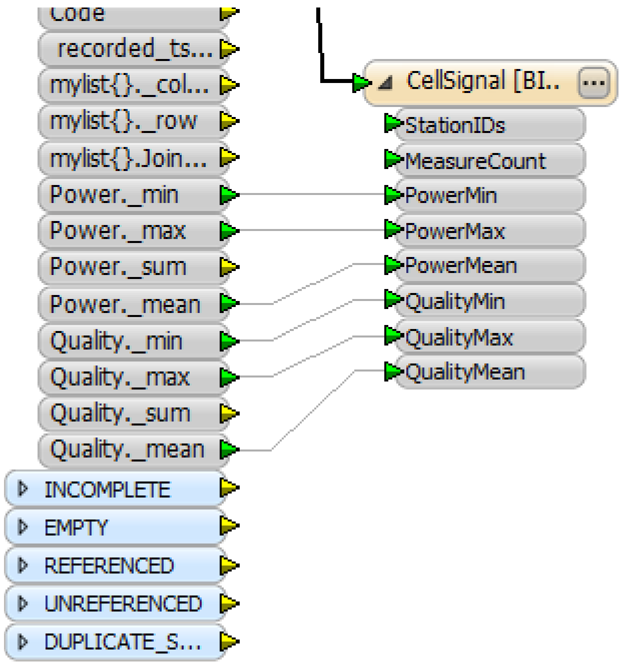
Open the properties dialog for the Writer feature type. Click on the User Attributes tab and delete all the existing attributes. Then add a set of new attributes as follows:

StationIDs	char	255
MeasureCount	char	255
PowerMin	float	
PowerMax	float	
PowerMean	float	
QualityMin	float	
QualityMax	float	
QualityMean	float	



Name	Type	Width	Precision	Index
StationIDs	char	255		
MeasureCount	char	255		
PowerMin	float			
PowerMax	float			
PowerMean	float			
QualityMin	float			
QualityMax	float			
QualityMean	float			

Then connect up the appropriate attributes from the FeatureMerger to the Feature Type (for example connect Quality._min to QualityMin.



6) Run Workspace
Ensure that Writers > Redirect to Inspection Application is turned off. Delete any remaining Inspector transformers.

Now save the workspace and then run it using File > Prompt and Run.

Experiment with using different values for grid size and units. What do you notice about the performance compared to the grid size?

Inspect the output in the FME Data Inspector to ensure it is correct.

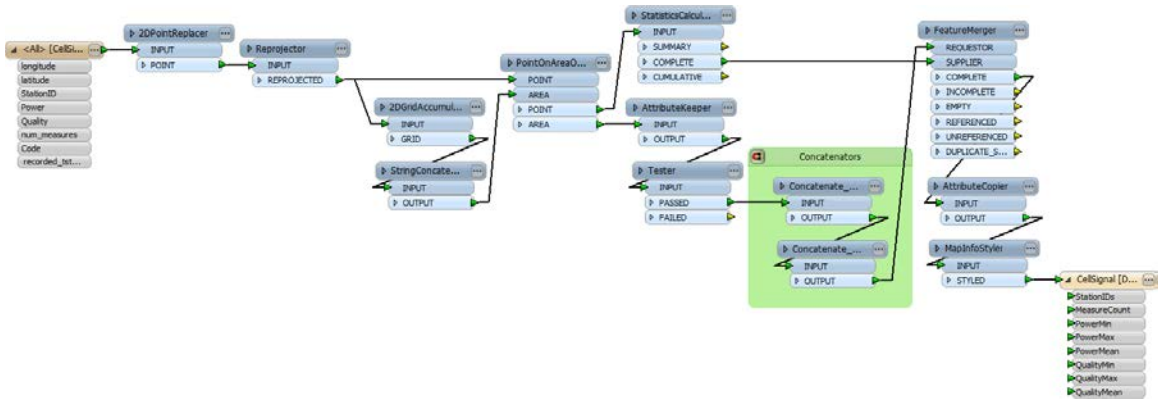
Congratulations! You have now finished this project!

7) Advanced Tasks
OK, there are a couple of other things we can do to finish up.

Manual attribute mapping – i.e. dragging connections like we just did – is frowned upon in FME because such connections are liable to be broken. So, right-click on the dark connection between the FeatureMerger and the writer Feature Type and choose the option Replace with AttributeCopier.

Can you see what has happened? The fragile links have been replaced by a more robust transformer mapping.

The other task we can do is add a MapInfoStyler transformer, just before the writer Feature Type, in order to style the data to look good in MapInfo; so try that.



And, finally, if you are up for the challenge, you can try running the workspace on the entire set of features. You can do this by simply deleting whatever value is in the Max Features to Read parameter and leaving it empty.

On my computer, with a 5000 metre grid, it ran in four minutes.