TELECOM FIBER EDITING TOOLS REFERENCE GUIDE

Version 1.2

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1. Overview and Getting Started

This document is for reference by individual end users responsible for the generation, editing, and tracing of fiber telecommunications network data with the Esri Telecom Fiber Tools toolbar. These tools were developed by ESRI and made freely available for download along with a supporting data model and application source code from ESRI's website and is intended for use with version 10.2 of ESRI's ArcGIS for Desktop Standard or Advanced (ArcEditor or ArcInfo) software license level.

This document assumes the reader is familiar with ESRI's ArcGIS Desktop product from an end user's perspective as well as with ESRI geodatabase concepts, including feature classes, tables, relationship classes, and geometric networks.

The tools described are specific to the editing and management of fiber optic telecommunications and do not offer specific functionality for copper (or other) networks at this time.

The tools provide specialized functions for editing and maintaining fiber telecommunications and conduit network map features, including network devices, fiber cables, splice closures, conduit, and structures. In addition they facilitate configuration and management and tracing of the lower level interconnectivity and relationships of individual ports, fiber strands, fiber splices, buffer tubes, and duct work.

This document provides an introduction to the end user functions available from the Telecom Fiber Tools toolbar, including important configuration details that can impact the correct operation of the tools.

Please read the installation and configuration sections to ensure your editing environment is setup correctly before attempting to use the tools.

2. Installation and Configuration

2.1. Installing the tools

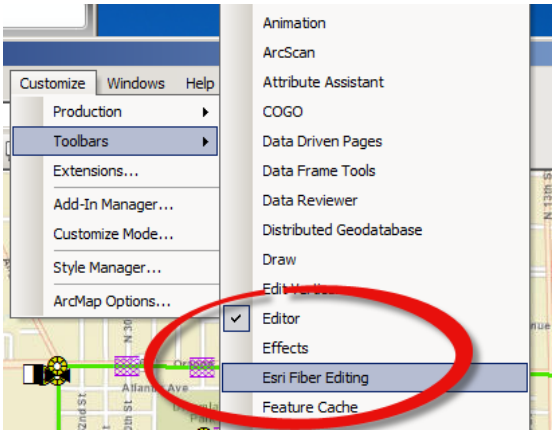
The Esri Telecom Fiber Tools add-in must be installed following the installation of the ArcGIS Desktop application. Note that ArcGIS for Desktop **Standard** level is the minimum license required in order to use these tools. ArcGIS for Desktop **Basic** will not work with these tools.

How to install the tools

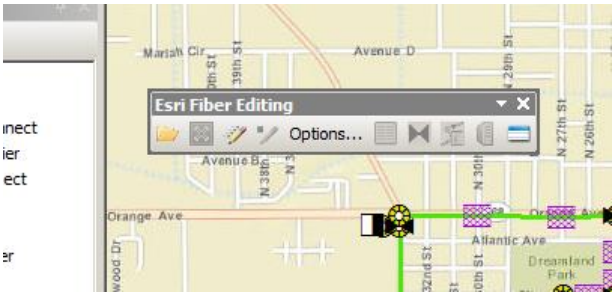
1. For instructions on how to install/uninstall the tools please see the document ***Getting Started.pdf***

2.2. Enabling the Esri Fiber Editing Toolbar

Once you have installed the Add-In, you can access the fiber editing tools via the toolbars menu if not already enabled. To do this click **Customize->Toolbars->** and select **Esri Fiber Editing** from the list. The toolbar will appear floating in the ArcMap window.



The Esri Fiber Editing Toolbar should now be shown as follows:



The tools available on the toolbar allow you to:

- Open and close a fiber editing workspace
- Start and stop an edit session
- Select and edit telecom network map features and their attributes.
- Specify the configuration of fiber cables and telecom devices
- Configure the interconnectivity of devices, splices, and fiber at the level of individual ports and strands
- Trace the fiber network at the fiber strand level
- View diagnostic log information associated with the tools

More details on the individual tools and their operation are detailed in section 6 of this document.

3. Standard Editing Practice and Workflow

The Esri Fiber Editing tools perform some complex editing operations; for instance when a cable is created it is not simply creating one feature but creating a whole series of features that are related and interdependent on each other. A cable consists of multiple buffer tubes and within those lives the many fiber strands that provide the communication media.

The standard editing workflow for using these tools is as follows:

1. Use the fiber editing toolbar **Open Workspace** command to select and validate an Esri Fiber tools workspace

2. Use the fiber editing **Start Editing** command to start an edit session

3. Use the **Create Features** window to create and place cables and devices

4. Use the **Fiber Splice** tool to edit or view connectivity information between cables

5. Use the **Fiber Device Connections** tool to edit or view connectivity information between cables and devices

6. Use the **Fiber Network Trace** command to run a detailed connectivity trace along a strand within a cable

7. Use the **Stop Editing** command to save and close your edits

8. Use the **Close Workspace** command to close out your editing session

Due to these many complex relationships users of the fiber editing tools must adhere to some basic editing restrictions and workflows. Some of these are limitations of the how the tools are implemented at this time and special care must be taken to confirm to these rules.

Some key points of operation when using these tools are:

1. Do not use an edit session on a telecom workspace without using the fiber editor toolbar to first open that workspace. Without first opening a telecom workspace for editing means that none of the event listeners will fire which create, maintain and remove the appropriate

relationships between the objects in the data model. Doing so will invalidate the integrity of the data model contents.

2. Do not use the standard editor toolbar to perform complex geometry operations that recreate or split features. Doing so will invalidate the integrity of the data model as logic does not exist at this time to update the relationships between the new geometry and its previously related items (conduit, buffer tubes, and strands). Using standard editing tools to move the vertices of an existing cable IS allowed since this does not recreate the feature.

4. Known Limitations of the Tools

Known limitations of the tools at this time:

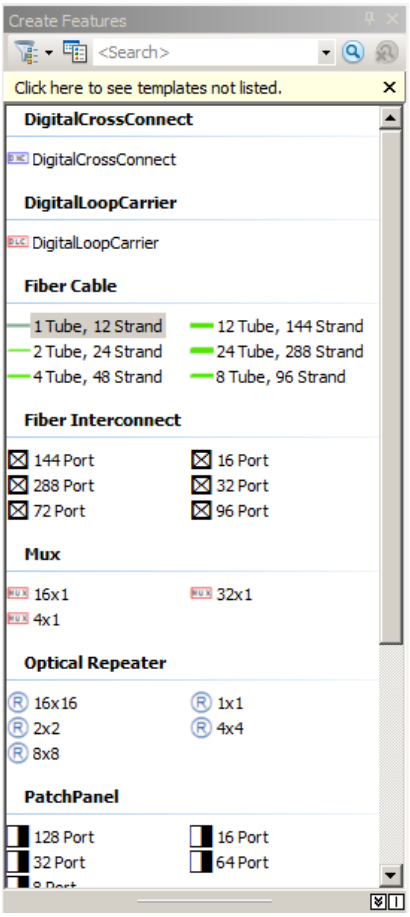
1. Mid cable splicing of cables is not support whereby the cable sheath is cut and several strands are pulled out to service a business or residence. All cable splicing must exist at the end points of cables. As previously stated using the Split tool to cut the cable will invalidate the integrity of the model. If you need to do this you must model this by deleting the cable and creating 2 cables so that a splice location can be placed.

2. Tracing is only supported through cables and splice closures. If a trace reaches a device the trace will stop at the device and port # it is connected to. The trace mechanism at this time does not have enough information on the internal workings of devices to decide how to continue the trace on the input or output side. This logic will vary per device.

5. Important Configuration Steps

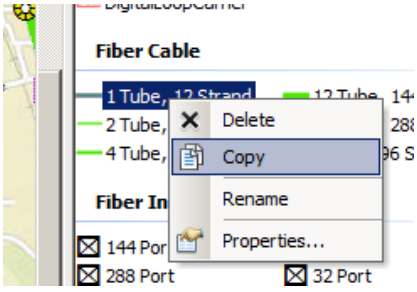
5.1. Creating New Fiber Cable & Device Configurations

The 10.1 (later versions) and 10.2 version of the Esri Fiber Editing tools use the standard Create Feature and Feature Template mechanisms. The default database and map document come with a default set of cable and device configurations. This set of configurations is not all inclusive and you will need to add to the list of items available.

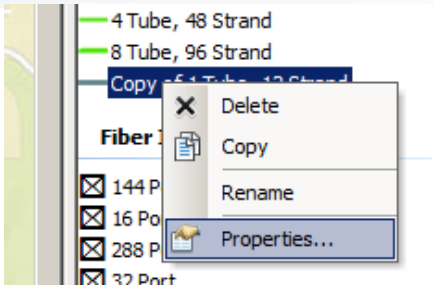


For example to add a new configuration of cable do the following steps:

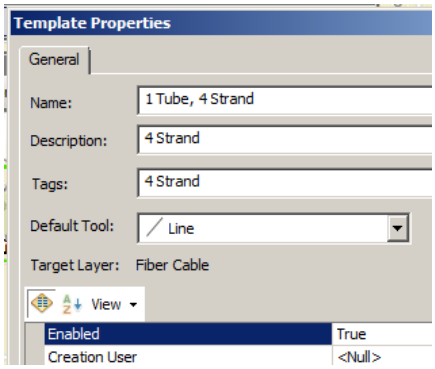
- Open the telecom workspace.
- Start an Edit Session.
- Open the Create Features window (shown to the right)
- Right click an existing cable configuration and **Copy** it. A new item named "Copy of …" will appear.



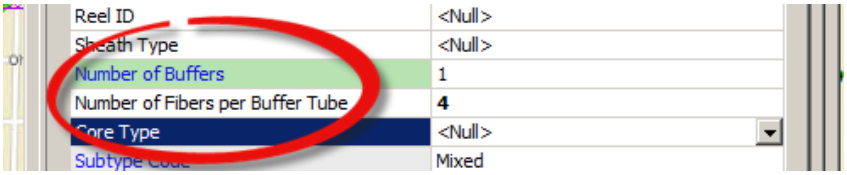
- Right click the new item and click **Properties** to edit this feature template.



- Enter a new Name (removing "Copy of"), Description and Tags corresponding to the new cable configuration you are creating.

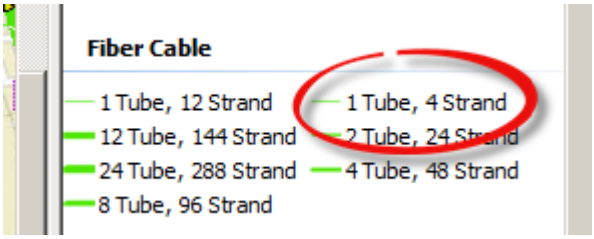


- Scroll down in the template properties to find the entries for Number of Buffers and Number of Fibers per Buffer Tube. Enter the correct values corresponding to your new cable configuration.



- Click **OK** to update this new template item.

- You should now see your new cable configuration in the template list.



The same mechanism can be used to create new Device port configurations.

More more information on editing feature templates please reference:
http://resources.arcgis.com/en/help/main/10.2/index.html#/About_feature_templates/01m700000022000000/

5.2. Snapping Environment

Geometric network connectivity is used by some of the tools to identify the specific cables and connections being used during connectivity operations. In order for this connectivity to work properly certain features need to be snapped to other features.

The following table lists some of the common types of snapping relationships that are required by related objects and operations such as splicing:

Items to snap	Reason
Cable to Cable endpoints	Required by any cables you want to splice together
Cable end points to Splice Closure	All cable splices must exist within a splice closure
Cable end points to Device	Cables must be snapped to device in order to make connections to it

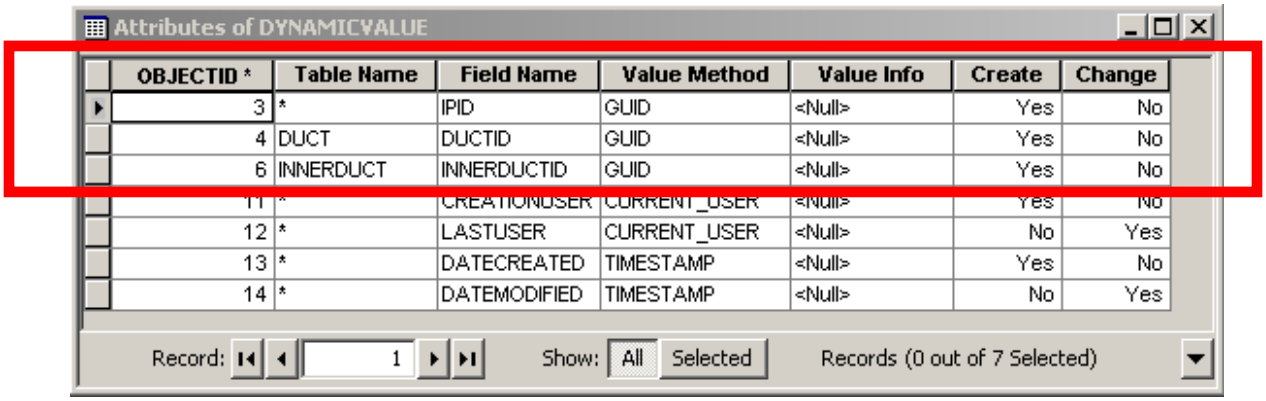
Proper snapping of Fiber Cables, Devices, Terminations, and Splice Closures is mandatory for the many of the Telecom Editing tools to work.

If you do not see any features that you expect in any dialog drop downs make sure that the features are snapped to the appropriate objects.

5.3. Dynamic Values

The Esri Telecom Fiber Tools utilizes a dynamic values capability that auto populates certain feature field values. This allows us to auto populate content field values such as Creation User, Last User, Creation and Edit time stamps etc without the need for user input. **The fields that are auto populated is controlled by a table named DynamicValue**. This table can be edited to include addition fields that you wish to have auto-populate.

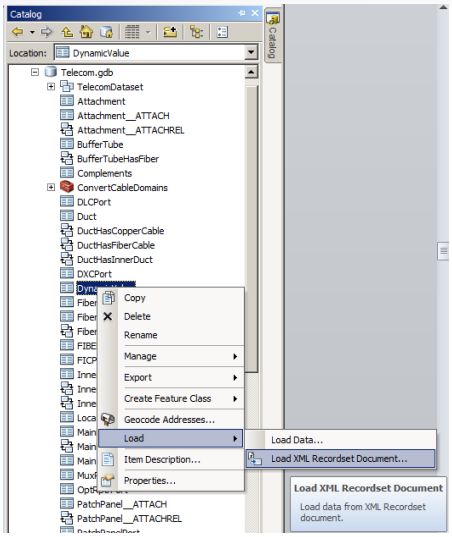
Some of these values in this table are NOT optional and removing them from the configuration setup will break the operation of the tools. These important field values are highlighted in the table below:



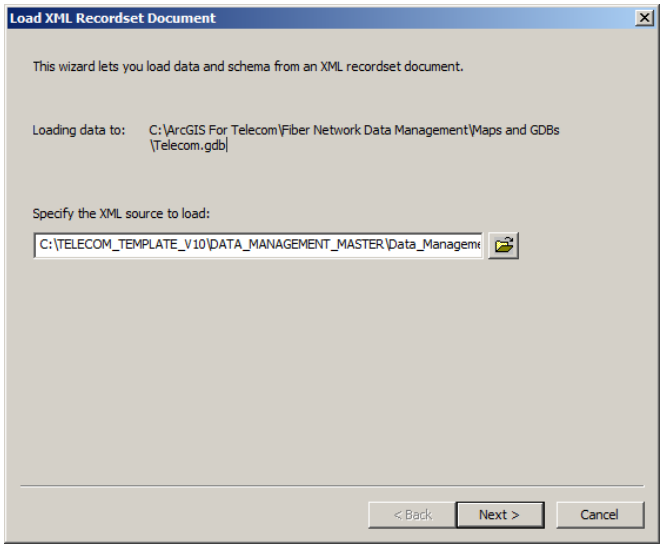
OBJECTID *	Table Name	Field Name	Value Method	Value Info	Create	Change
3	*	IPID	GUID	<Null>	Yes	No
4	DUCT	DUCTID	GUID	<Null>	Yes	No
6	INNERDUCT	INNERDUCTID	GUID	<Null>	Yes	No
11	*	CREATIONUSER	CURRENT_USER	<Null>	Yes	No
12	*	LASTUSER	CURRENT_USER	<Null>	No	Yes
13	*	DATECREATED	TIMESTAMP	<Null>	Yes	No
14	*	DATEMODIFIED	TIMESTAMP	<Null>	No	Yes

A DynamicValues.xml file is include in the Maps and GDBs folder of the tools. This file contains a base configuration of the minimal values required for the tools to operate. When creating new editing database be sure to populate the DynamicValue table with the contents of this xml file. This can be done as follows:

- Within the **Catalog** window of ArcMap find the **DynamicValue** table in the new GeoDatabase.
- Right click on this table and select **Load->Load XML RecordSet Document**.

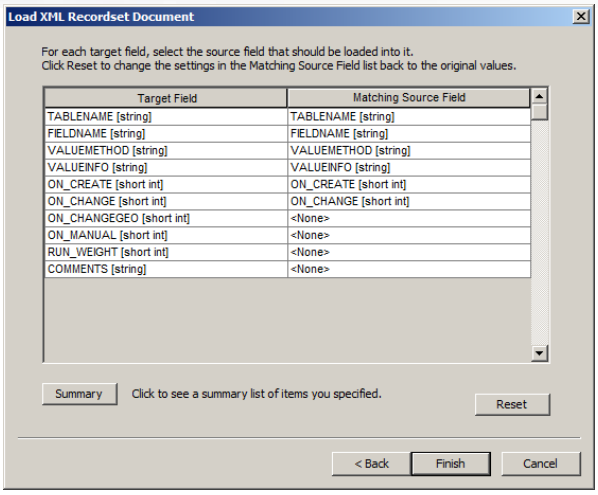


- Browse to the location of the DynamicValues.xml file provided with the install.

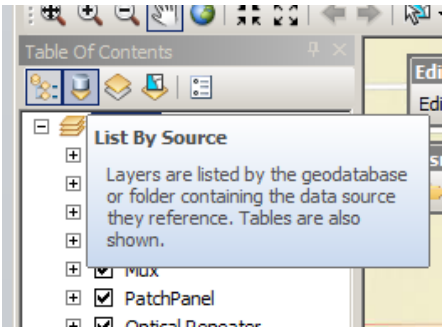


- Click **Next**.

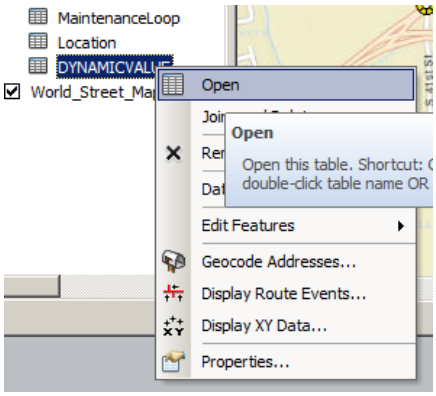
- Accept the defaults on this next dialog and click **Finish**. The XML values will be imported.



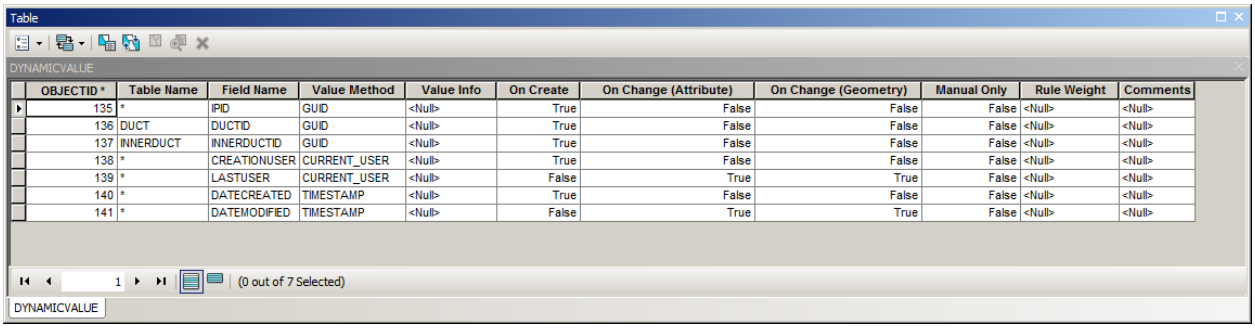
- To confirm the import was successful. Find the DynamicValues in the Table of Contents…
- Click **List By Source**



- Select the DynamicValue table and right click.
- Select **Open** to open the attribute table.



- The table should now show valid values as follows:



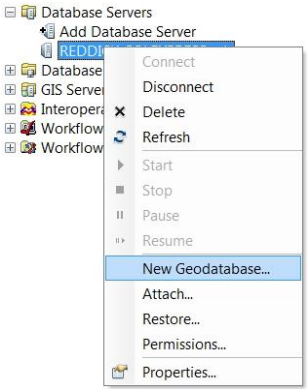
OBJECTID *	Table Name	Field Name	Value Method	Value Info	On Create	On Change (Attribute)	On Change (Geometry)	Manual Only	Rule Weight	Comments
135	*	IPID	GUID	<Null>	True	False	False	False	<Null>	<Null>
136	DUCT	DUCTID	GUID	<Null>	True	False	False	False	<Null>	<Null>
137	INNERDUCT	INNERDUCTID	GUID	<Null>	True	False	False	False	<Null>	<Null>
138	*	CREATIONUSER	CURRENT_USER	<Null>	True	False	False	False	<Null>	<Null>
139	*	LASTUSER	CURRENT_USER	<Null>	False	True	True	False	<Null>	<Null>
140	*	DATECREATED	TIMESTAMP	<Null>	True	False	False	False	<Null>	<Null>
141	*	DATEMODIFIED	TIMESTAMP	<Null>	False	True	True	False	<Null>	<Null>

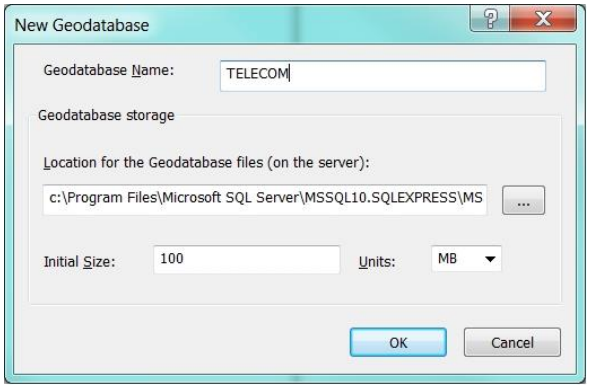
5.4. Using the Fiber Tools With an Enterprise GDB

The Esri Telecom Fiber Editing tools are fully enterprise GDB ready. In order to create a new GDB in the correct spatial projection of your choice please follow these steps:

- **Open** the original map document **Fiber Network Data Management.mxd** shipped with the template download.

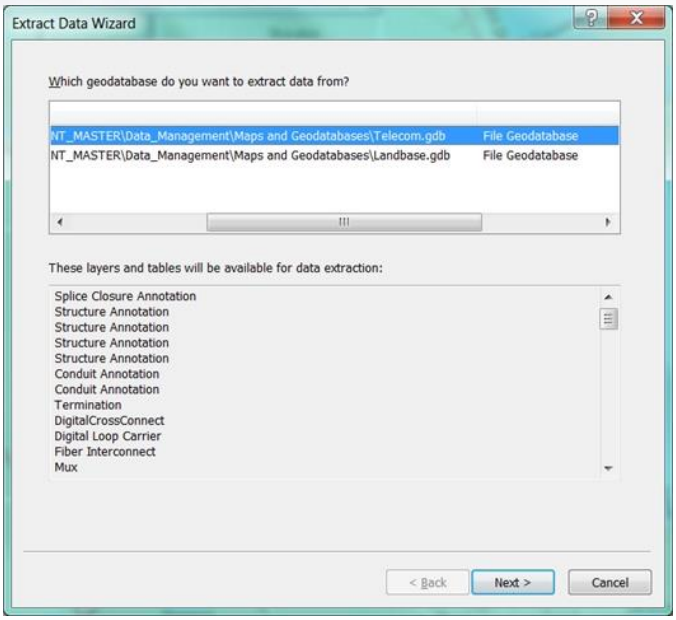
- From the **Catalog** window **create a new enterprise geodatabase** on the DB platform of your choice.



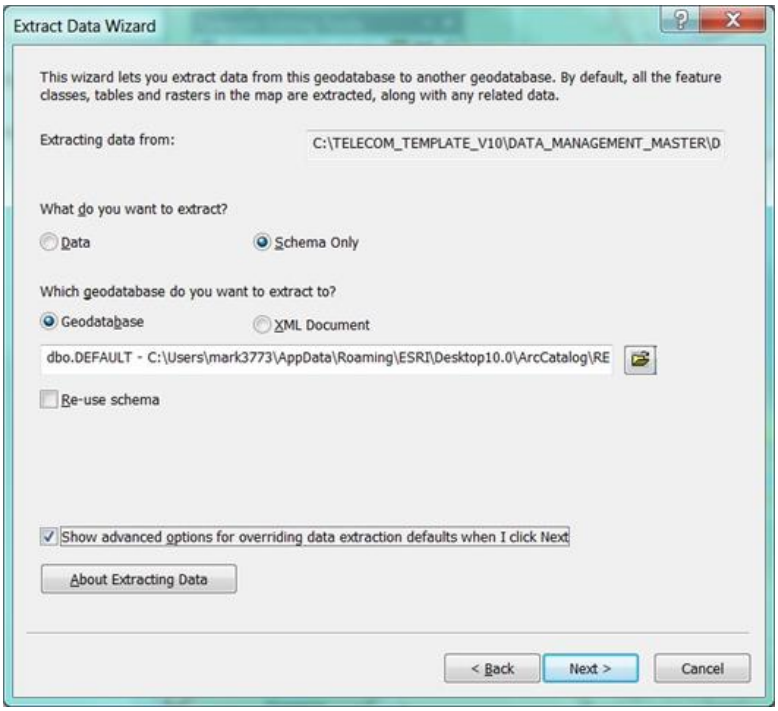


- Use the **Customize->Toolbars** menu to open the **Distributed Geodatabase** toolbar and click the **Extract Data** tool (far right) to initiate a GDB to GDB export specifying the new projection information. **If this tool is not enabled then you may not have the correct license level to use these tools (if so please read section 2.1 of this document).**

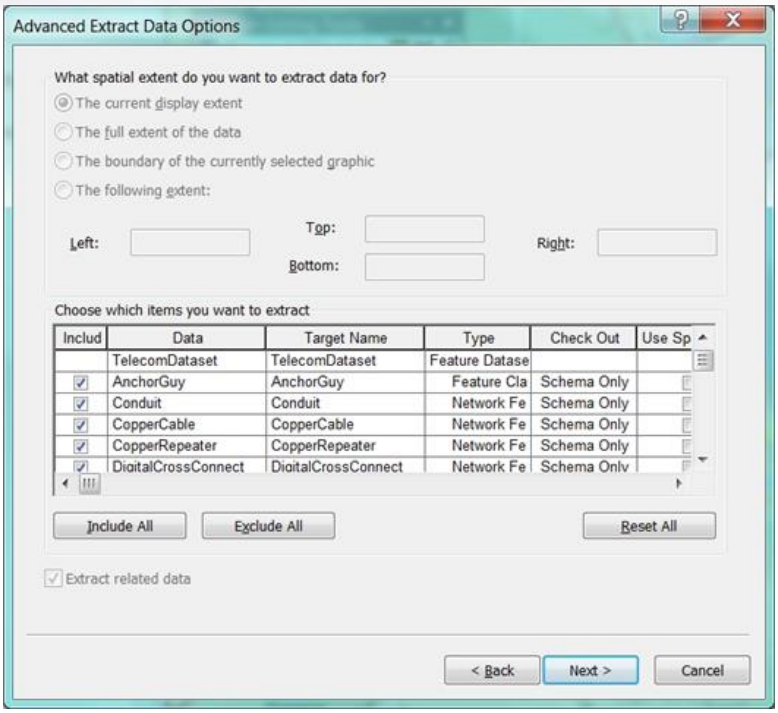
- Select the **Telecom** geodatabase that we will extract the schema from....



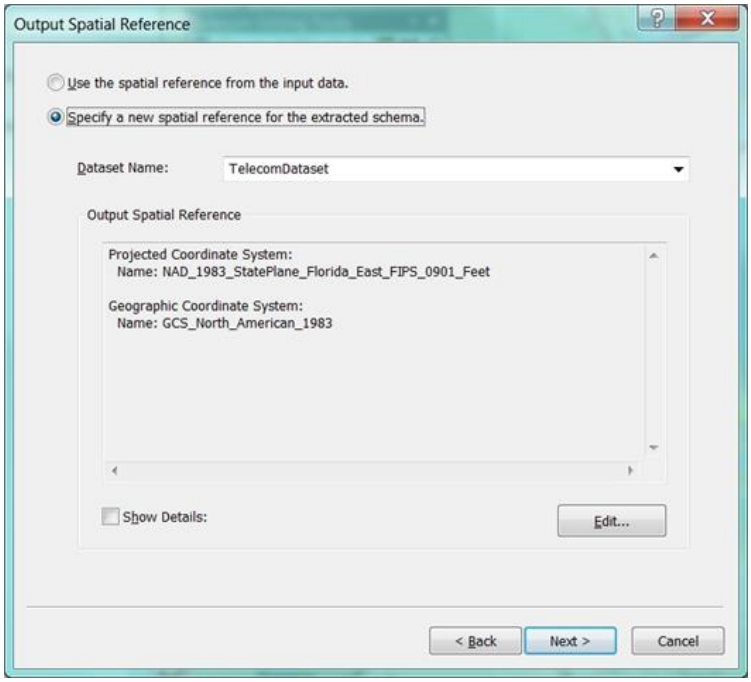
- **Click Next**. Specify **Schema Only** and set the output location to the enterprise GDB we created above. Ensure the **Advanced Options** check box is selected.



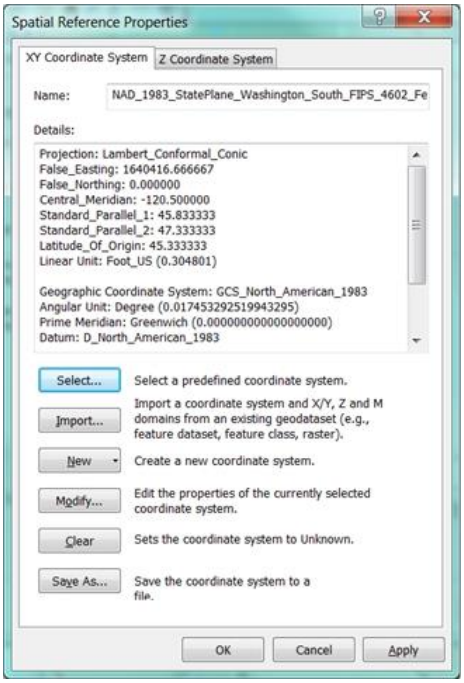
- Leave the following options as the defaults...



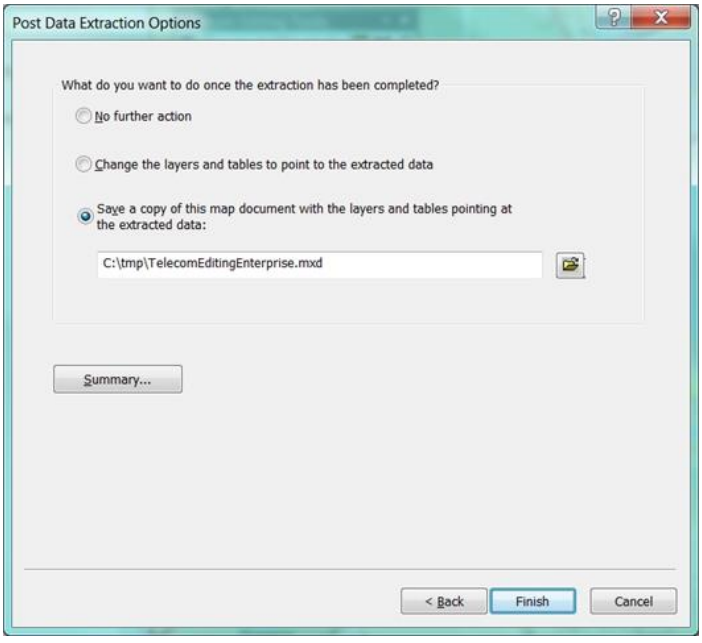
- Now we get to select a new local projection for our output geodatabase. **Click Edit** to see a list of projections to choose from...



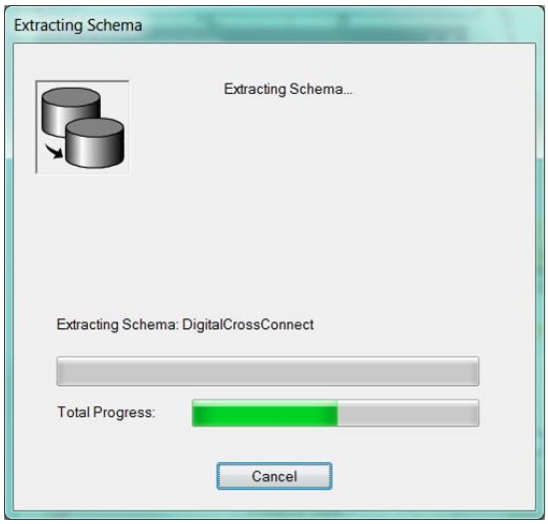
- The **Spatial Reference Properties** dialog showing the new projection (in this case for Washington State Plane South)...



- Next **choose a location for a new MXD** that will be created referencing the enterprise database we will populate with the new schema...

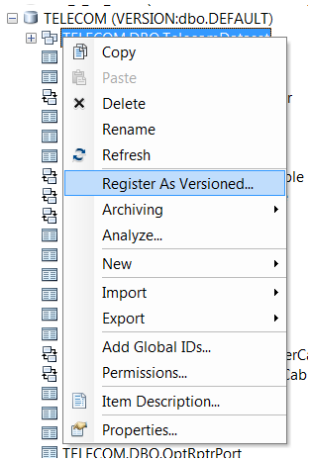


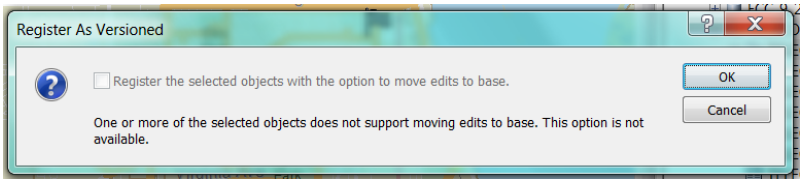
- Click **Finish** and the extract process will run re-projecting the database schema at the same time...



- **Import the minimum required Dynamic Values settings (see section 5.3 of this document)**. These settings need to be imported for the editing tools to function correctly.

- **Register the database as versioned**. This will enable multi-user versioned access. Do this by right clicking on the **TelecomDataset** and selecting **Register As Versioned**. Click OK when prompted.





5.5. Migration of Existing Databases

As updates to the telecom data model are made we will attempt to provide mechanisms for users to update their existing databases through the inclusion of GP models that perform the required changes. However given the nature of the tools (being unsupported sample implementations) we will not always be able to provide such migration support when more complex updates are done.

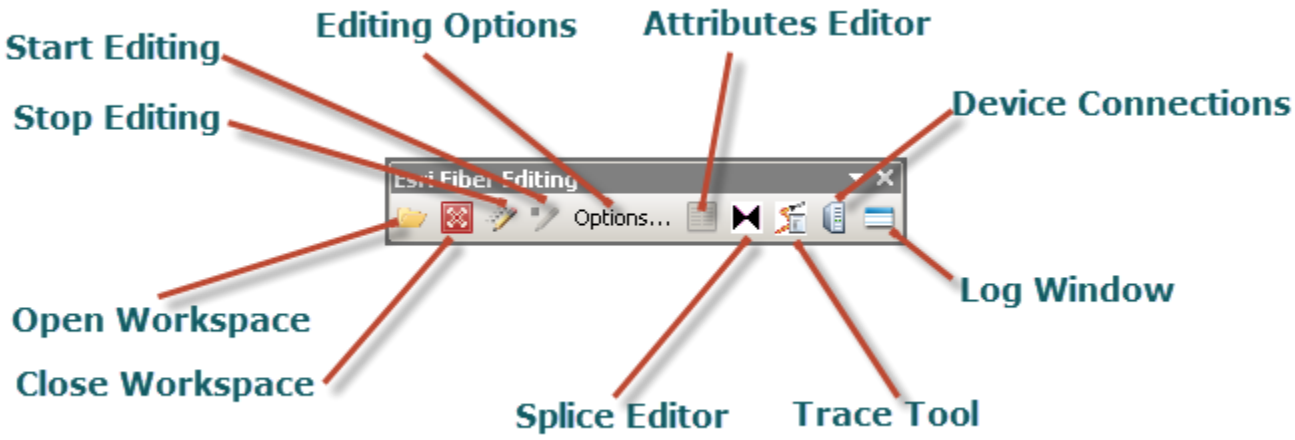
We will try to minimize the impact of any changes made and record details of all such changes between versions to aid in any migration efforts.

6. Tools Overview

The Telecom Fiber Editing Tools provide you consolidated access to standard commercial, off the shelf (COTS) selection and editing functions as well as customized tools for defining the characteristics, connectivity, and inter-relationship of fiber telecommunications data elements, including fiber bundles, conduit, devices, and splices. The toolbar also provides basic fiber telecommunications network tracing functionality.

A number of the tools are only active within an edit session in ArcMap and also only when certain types of map features are selected (devices, fiber cables etc).

Some tools will automatically engage the ArcMap Feature Selection tool since they operate on a selection set and will populate information when the user selects one or more features on the map. If necessary, add layers to the list of selectable layers by switching to the "List By Selection" tab in the Table of Contents and checking them.



The Telecom Fiber Editing Tools contain a number of standard ArcMap tools as well as specialized tools and commands specifically created for creating, managing, and editing fiber telecommunications network connectivity, both among map features, such as fiber cables, devices, and splice closures, as well as lower level connectivity and relationships such as fiber strands and device ports, and duct and inner ducts to fiber strands. These tools operate against a standardized ESRI geodatabase model.

The following sections describe each command on the Telecom Fiber Editing Tools toolbar.

6.1. Workspace Commands

6.1.1. Open Workspace

This tool allows you to open a particular telecom fiber workspace. A workspace must be select in order to initialize the tools for use. Performing editing on a telecom workspace without first opening it is not supported and may invalidate the workspace. The tools on the fiber editing toolbar will not be enabled until this step is carried out.

The act of opening a workspace carries out validity checks on the database selected by the user. If a workspace is found to be invalid please check the Log Window for more details on the cause.

6.1.2. Close Workspace

This tool closes the current telecom editing workspace after you have finished an edit session. Closing the workspace will disable all telecom fiber editing tools.

6.2. Standard Editor Commands

These commands are part of the standard ArcMap Editor toolbar and have been added to the Telecom Fiber Editing toolbar for convenience.

6.2.1. Start Editing

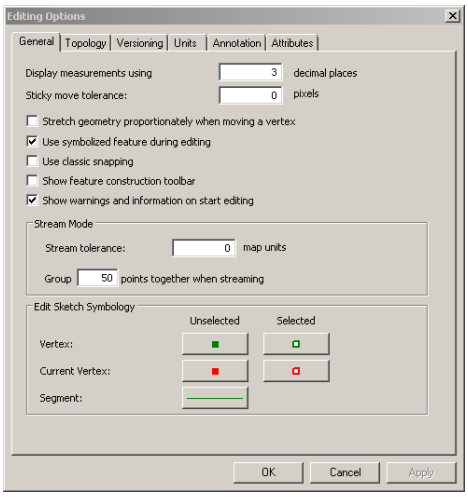
This is the standard Start Editing command. Starts an edit session on the current telecom workspace.

6.2.2. Stop Editing

This is the standard Stop Editing command. Stops the edit session on the current telecom workspace.

6.2.3. Editing Options

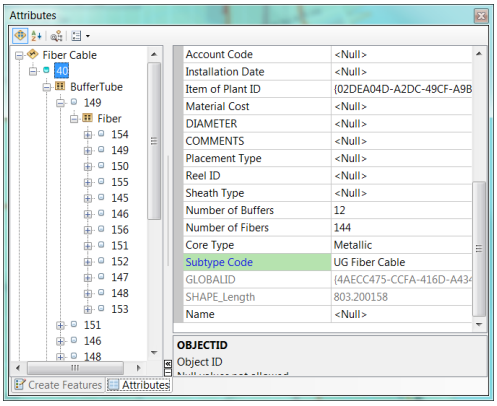
This is the standard Editor Options command. Gives users access to the standard editing options such as tolerances for snapping, version conflict resolution etc.



6.2.4. Attribute Editor

This command opens the Attributes dialog box which displays the attributes of all selected features. The attributes may be edited if an edit session has been started.

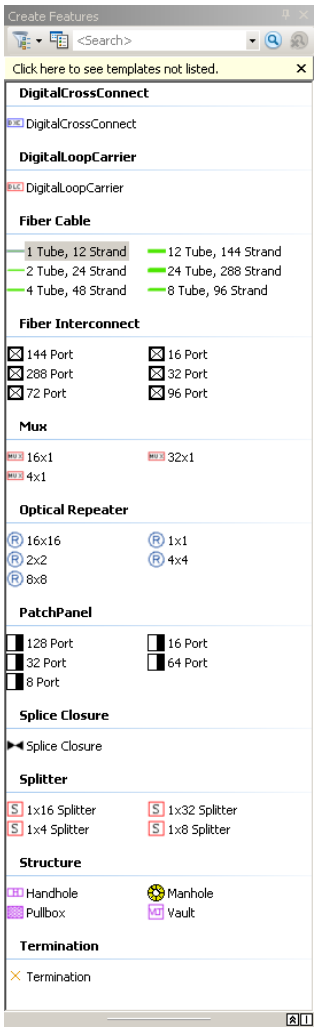
This tool also allows you to create tabular records, or objects, related to selected features, such as Ducts and Innerducts of a Conduit, and to relate selected features participating in a relationship class, such as Ducts and Fiber cables. This functionality can be accessed through the right-click shortcut menu within the dialog when an item has been selected.



This is the standard ArcMap tool for editing Attribute values.

6.3. Creating Cables and Devices

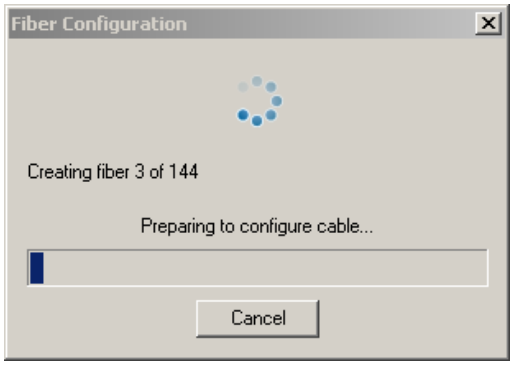
Cable and device creation is a very straight forward process using the standard feature template editing mechanisms. Creating a new cable or device is as simple as picking the appropriate item in the feature palette of the Create Features window and sketching the geometry (a line for cables) or picking the location (a point in the case of devices).



If the Create Features window does not show up when you open a telecom workspace and start an edit session it can be access as follows:

- From the menu: Select **Customize->Toolbars->Editor**
- From the Editor Toolbar: Click **Editor->Editing Windows->Create Features**

When creating new features for some types (devices and cables) you will notice some custom behavior beyond the normal editing experience. As you create cables and devices of a specific configuration a popup progress dialog will appear briefly. This shows the progress of creating the related features for the cable or devices type in question. For example creation of a cable creates all the buffer tubes and strands that are contained within that cable. The tools take care of creating all these additional database records rather than making the user populate this information.



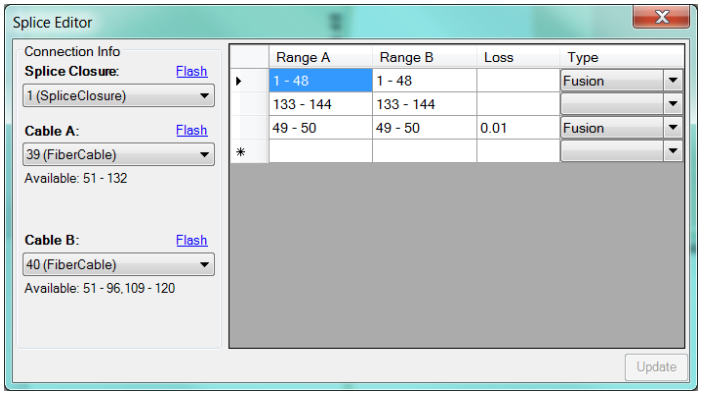
If you do not see this dialog then make sure you are not editing the database outside of an edit session where a telecom workspace has been opened (see section 6.1.1). This step must be carried out for the tools to work as expected.

For more information on configuring new device and cable types please see section 5.1.

6.4. Viewing, Editing and Tracing Cable/Device Connections

6.4.1. Splice Editor

The Splice Editor tool allows users to define the fiber strand ranges to connect to other fiber cable sections terminating their length at a given splice closure. The tool also allows users to specify the type of physical fiber connection and any losses associated with it.



The Cable A and Cable B controls list the cables connected (snapped) to the selected SpliceClosure. Select the correct features for the Splice Closure, Cable A, and Cable B controls from the available options. Cable A should be the cable upstream from the splice. If necessary, click the Flash links to highlight the selection in the map view for confirmation.

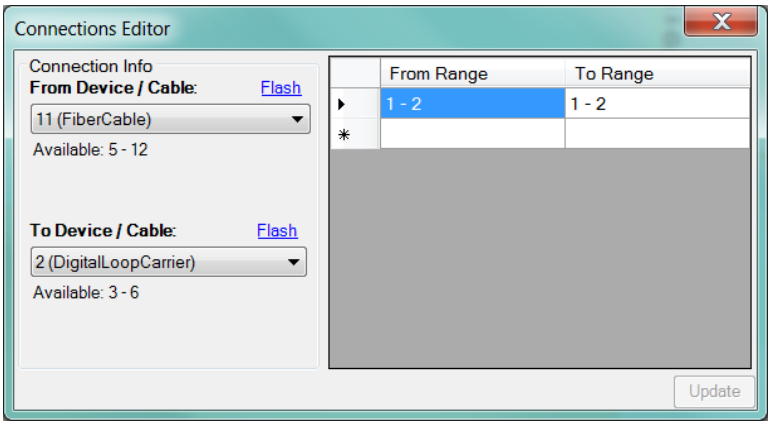
Available fiber ranges are shown below each dropdown for the currently selected cable. If there are no available ranges for a cable, the dialog will state 'No available ranges!' below the dropdown.

Define the Range A, Range B, Loss, and Type values each Fiber Splice within the SpliceClosure and then set these values by clicking the Update button in the lower right. An error message will display if an update is attempted with invalid range values.

Fiber cables must be snapped at their endpoint to a splice closure and another fiber cable or it will not be possible to configure the connectivity (for more information on snapping requirements see section 5.2).

6.4.2. Connections Editor

The Connections Editor allows users to specify the connectivity between cables and devices (Digital Cross Connects, Multiplexers, etc.) including the ranges used at the individual fiber level and both the input and output port level.



The dialog lists devices and any cables connected to it in the From and To Device/Cable combo box drop down controls. Select the appropriate device and cable from the available options. If necessary, click the Flash links to highlight the selection in the map view for confirmation.

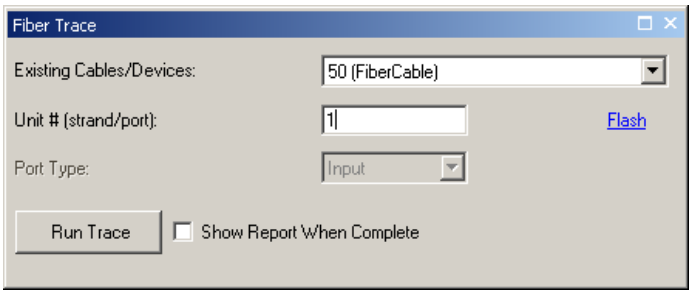
Define the From Range and To Range values for the ports of the device that the FiberCable fiber strands connect to and then set these values by clicking the Update button. If there are no available ranges for a selected device or cable, the dialog will state 'No available ranges!' below the corresponding dropdown. An error message will display if an update is attempted with unavailable or invalid range configurations.

The results of edits can be seen by clicking the Attributes tool from the Editor or Telecom Editing Tools toolbar and drilling down from the device to the related port records in the Attributes dialog.

Fiber cables must be snapped to devices at their endpoint or it will not be possible to configure connectivity (for more information on snapping requirements see section 5.2).

6.4.3. Fiber Strand Tracing

The Telecom Fiber Editing Tools toolbar provides the ability to trace a specified port or fiber strand from a selected device or fiber cable based on the interconnectivity configured with the other Telecom Editing tools.

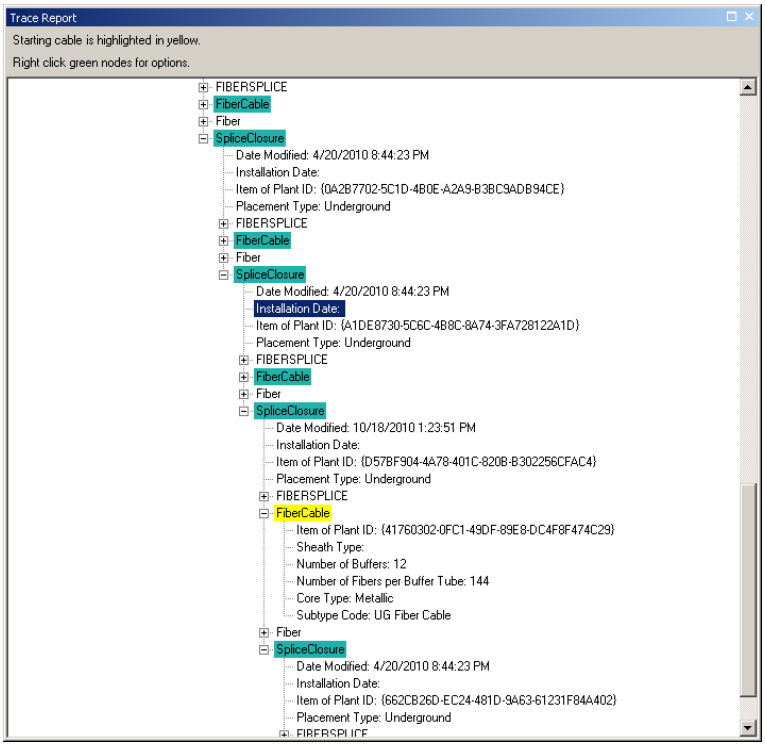


The dialog will be displayed listing the selected devices or fiber cables in the Existing Cables/Devices combo box drop down control on the dialog. Select the device or FiberCable containing the Port or Fiber to be traced from the drop down control and specify the Port or Device number in the Unit Number (strand/port) text box. Notice that the feature specified in the dialog will be highlighted in the map view. The feature can also be highlighted by clicking the Flash link. Only a single fiber strand or port can be traced at a time.

Click the Run Trace button on the Fiber Trace dialog to run the analysis. The results of the trace will be displayed in the Trace Results dialog and selected in the map. The Trace Results dialog lists details of the trace, including an ordered list of all of the devices, splice closures, and fiber cables that the fiber strand or port is connected to.

If necessary, choose the Selection>Zoom to Selected Features option to set the map extents so that you can see the entire route of the traced fiber or port connections.

The Start point of the trace is always highlighted in Yellow. Nodes/Features that are locatable geographically on the map are highlighted in Green; right click on these items to flash their location on the map.



Note: At this time the telecom data model does not support tracing through devices. A trace that is executed will pass through any number of cables and splice closures but will stop when it reaches a device and port on that device. Internal logic of how to trace through devices has not been implemented at this time.

In addition to the specialized, low level fiber telecommunication ArcMap provides standard capability for tracing the TelecomNetwork and ConduitNetwork features based on snapped, topological connectivity with the Utility Network Analyst. For more information on standard tracing of geometric networks with the Utility Network Analyst reference:

http://resources.arcgis.com/en/help/main/10.2/index.html#//002r0000002s000000

7. The Telecom Data Model

The Telecom Editing Tools have been built to work against a standardized fiber telecommunications data model[1]. As such, it is important that the feature class and table names and relationships of the database are not altered.

All the features in the model are created and edited with standard ArcMap editing capabilities and feature template editing capabilities. Some features however exhibit custom functionality when created, such as the creation of more than one feature per user feature sketched. As a result these objects should not be edited directly (outside of an fiber editing workspace session) with the standard edit tools unless you fully understand the model and the consequences of performing such edits.

For more information on Creating New Features and Edit Templates reference:
http://resources.arcgis.com/en/help/main/10.2/index.html#//01m700000022000000

The data model includes two Geometric Networks: TelecomNetwork and ConduitNetwork. The following lists the respective feature classes in each network and their roles in the network:

- **TelecomNetwork**
  - DigitalCrossConnect-Simple Junction
  - DigitalLoopCarrier-Simple Junction
  - FiberCable-Complex Edge
  - FiberInterconnect-Simple Junction
  - Multiplexer-Simple Junction
  - OpticalRepeater-Simple Junction
  - PatchPanel-Simple Junction
  - SpliceClosure- Simple Junction
  - Splitter-Simple Junction
  - TelecomNetwork_Junctions- Simple Junction
  - Termination-Simple Junction

- **ConduitNetwork**
  - Conduit-Complex Edge

[1] This model is based on, but varies slightly from Esri's telecom data model that was originally published back in 2007.

- Structure-Simple Junction
- ConduitNetwork_Junctions-Simple Junction

Inclusion of these features in Geometric Networks facilitates advanced management of feature interconnectivity functions.

Note that since Fiber Cables and Conduits are Complex Edges in the ConduitNetwork and TelecomNetwork, these objects will not be split into two separate features when a new Structure or object is placed along them.

Devices and splice closure junctions must be properly snapped to fiber edges or a number of the Telecom Editing Tools will not function properly. For example, both the Splice Editor and Connections Editor tools rely on properly snapped elements to determine the from and to features to display in the drop down combo box controls. If the network features are improperly snapped, the dropdown selection controls will be empty and the connectivity cannot be specified.

For more information on Geometric Network concepts reference: http://help.arcgis.com/en/arcgisdesktop/10.2/help/index.html#//002r00000001000000.htm

For more information on the Snapping Environment reference: http://help.arcgis.com/en/arcgisdesktop/10.2/help/index.html#//001t00000003t000000.htm

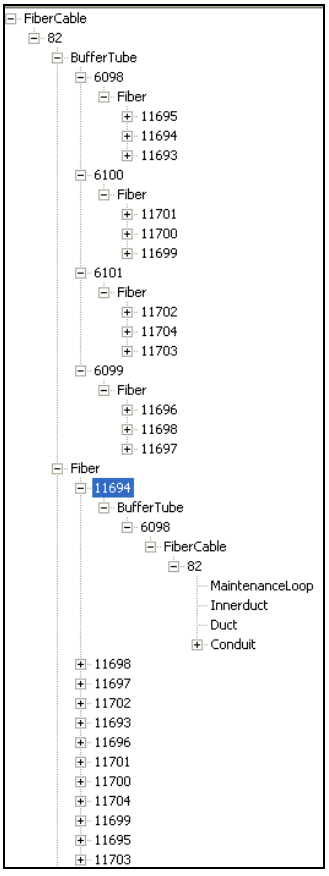
In addition to the network feature classes, the data model includes a number of tables and relationship classes specific to defining and managing the relationships and connectivity of the lower level telecommunications elements, such as individual ducts, sub-ducts, fibers, and ports. TheTelecom Editing Tools operate against these tables and simplify editing of this detailed, low-level telecommunication network connectivity.

The remainder of this section describes how the various edit operations operate against these tables and relationships.

7.1. Fiber Creation

When a Fiber Cable is created or updated, the appropriate numbers of records are created in the BufferTube and Fiber tables in the geodatabase and both are related to the relevant FiberCable feature.

In addition, the new, individual Fibers are evenly allocated to the new BufferTubes via the BufferTubeHasFiber relationship class. For example, if 12 Fiber strands and 4 Buffer Tubes are created, 3 Fibers are related to each BufferTube. The illustration below shows the various updates and relationships resulting from such a fiber cable creation.

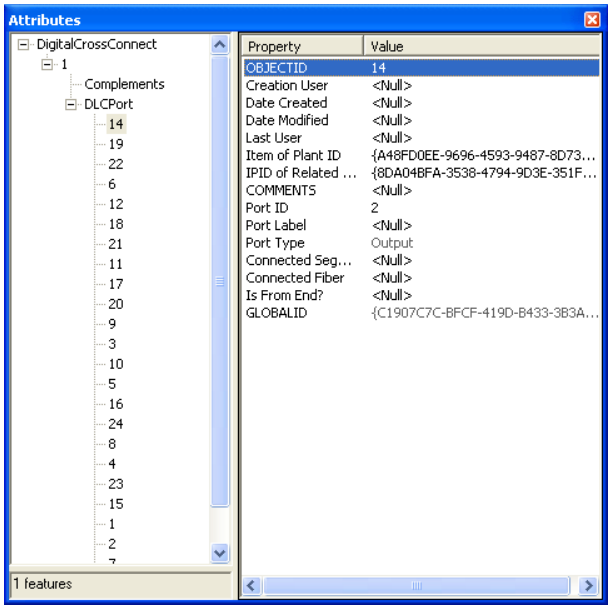


The table below lists the entities affected by the creation of a Fiber Cable.

Operates on	Updates	Relationship Classes
FiberCable feature class	BufferTube table	BufferTubeHasFiber
		FiberCableHasBufferTube
	Fiber table	FiberCableHasFiber

7.2. Device Creation

When a device is created, the tool creates the relevant number of port records in the port table related to the device (as elaborated in the table below). A port record is created for each input and output port, so for example, a device creation with 12 input ports and 12 output ports would results in 24 total new ports related to the device as shown below. In addition, the Port Type attribute will be set appropriately on the records.



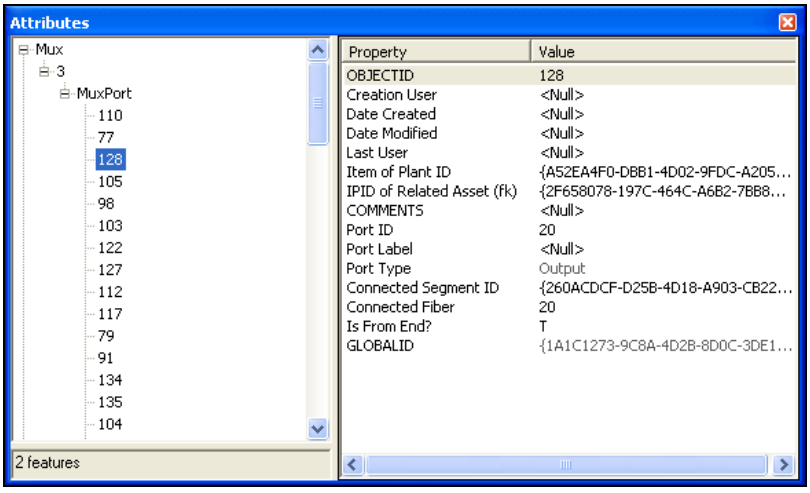
The table below lists the entities affected by use of this tool.

Operates on	Updates	Relationship Classes
DigitalCrossConnect feature class	DXCPort table	DCCHasPorts
DigitalLoopCarrier feature class	DLCPort table	DLCHasPorts
FiberInterconnect feature class	FICPort table	FICHasPorts
Multiplexer feature class	MuxPort table	MuxHasPorts
OpticalRepeater feature class	OptRptrPort table	OPTRHasPorts
PatchPanel feature class	PatchPanelPort table	PatchPanelHasPorts
Splitter feature class	SplitterPorts table	SplitterHasPorts

7.3. Connections Editor

The Connections Editor allows users to specify the from and to ranges for Fibers of Fiber Cables snapped to a device (Digital Cross Connects, Multiplexers, etc.). When a From Range and To Range are specified for the selected feature and updated, the Connected Fiber attribute of the devices related ports are updated to reflect this connectivity.

In the illustration below, a Mux device has been edited with the Connections Editor. Prior to the edit the Connected Fiber attribute of Port 20 was Null, however after the update, Port 20 has been connected to Fiber 20 of the Fiber Cable edge snapped to the Mux device junction in the TelecomNetwork.



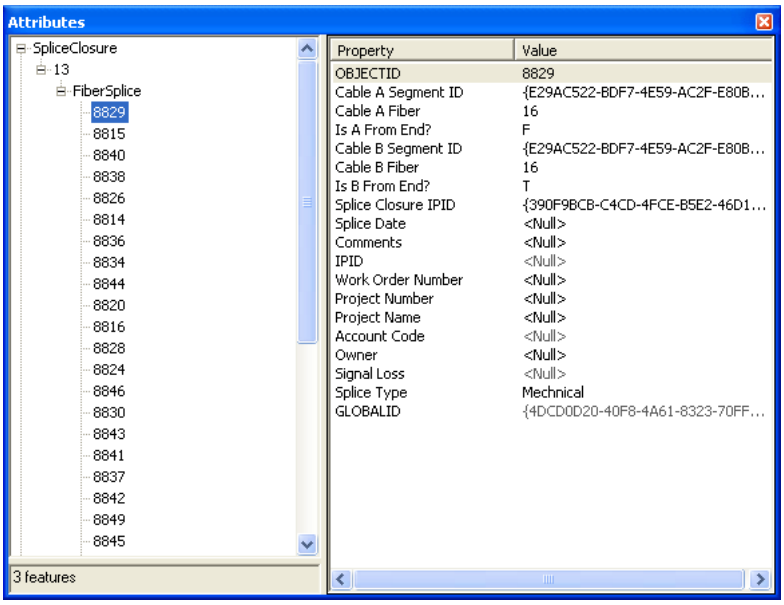
The table below lists the data entities affected by use of this tool.

Operates on	Updates
DigitalCrossConnect feature class	DXCPort table Connected Fiber attribute
DigitalLoopCarrier feature class	DLCPort table Connected Fiber attribute
FiberInterconnect feature class	FICPort table Connected Fiber attribute
Multiplexer feature class	MuxPort table Connected Fiber attribute
OpticalRepeater feature class	OptRptrPort table Connected Fiber attribute
PatchPanel feature class	PatchPanelPort table Connected Fiber attribute
Splitter feature class	SplitterPorts table Connected Fiber attribute

7.4. Splice Editor

The Splice Editor allows users to define the Fiber strand ranges for Fiber Cables connected to a SpliceClosure. When a SpliceClosure is edited with this tool, the tool creates records in the FiberSplice table indicating the from and to connectivity of the Fiber strands of the FiberCables connected to the SpliceClosure and relates these new FiberSplice records to the SpliceClosure feature.

The illustration below shows a number of newly created FiberSplice records related to a given Splice Closure; note the Cable A Fiber and Cable B Fiber attribute values showing that Fiber #16 of the incoming FiberCable is connected to Fiber #16 of the outgoing FiberCable.



The table below lists the data entities affected by use of this tool.

Operates on	Updates	Relationship Classes
SpliceClosure feature class	FiberSplice table	SpliceClosureHasSplices

7.5. Attributes and Relationship Editing

In addition to the custom Telecom Editing Tools described above, the standard ArcMap Attributes Tool is used to create some of the non-spatial tabular elements of the telecommunications geodatabase and relate them to the spatial telecommunications and conduit network features. This

functionality as it specifically relates to the telecommunications data model is discussed below.

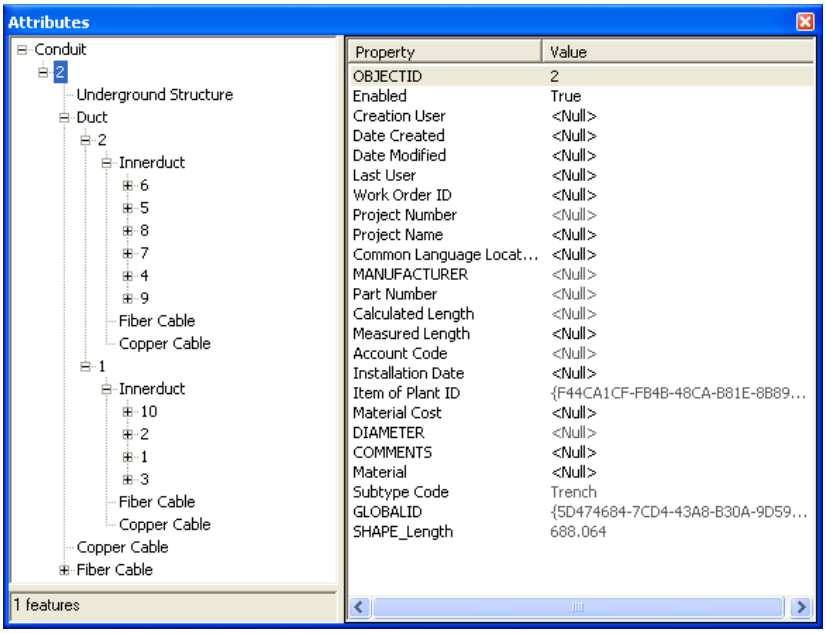
For further general information on editing related features and relationships, reference:
http://help.arcgis.com/en/arcgisdesktop/10.2/help/index.html#//001t000000m9000000.htm

7.5.1. Conduits, Ducts, and Innerducts

Conduit can contain ducts which may themselves contain innerducts. These physical relationships are modeled in the telecom geodatabase with relationship classes among Conduits, Ducts, and Innerducts.

To create these entities and their relationships, a new Conduit feature is first created with the standard Edit Template capabilities and the Attribute tool is used to open the Attributes dialog for the selected Conduit. Ducts and Innerducts can then be created and related to the Conduit and each other by selecting the 'Add New' option from the right click pop-up menu on the Duct or Innerduct node for the elements related to the Conduit.

As an example, the illustration below shows that the Conduit contains two Ducts, one with six Innerducts and one with 4 Innerducts.



The table below lists the data entities affected by use of this tool for these cases.

Operates on	Updates	Relationship Classes
Conduits feature class	Ducts table	ConduitHasDucts
Ducts table	Innerducts table	DuctHasInnerduct

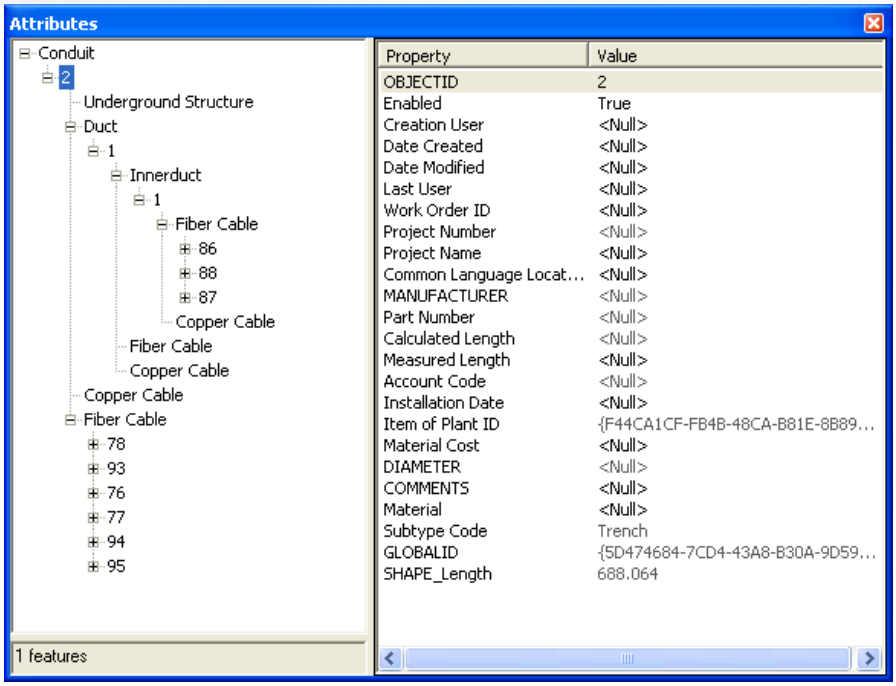
7.5.2. FiberCables, Ducts, and Innerducts

FiberCables may be directly contained within a Conduit, or may be contained within one of the Conduit's Ducts or Innerducts. This physical relationship is also represented by a geodatabase Relationship Classes in the telecom data model.

To create these entities and their relationships, a Conduit feature and, optionally one or more Ducts and/or Innerducts are created as described above and a FiberCable is created with the fiber edit template capabilities. The FiberCable and related Conduit can then be selected using the Edit Tool and the Attributes dialog opened to display the FiberCable and Conduit attributes. The selected FiberCable is related to the Conduit, Duct, or Innerduct by selecting the 'Add Selected' option from the right click pop-up menu on the Fiber Cable node of the Conduit, Duct, or Innerduct.

Note that if a Duct's Innerducts contain FiberCable(s), those cables will only be related to the Innerduct; in other words, the relationship is not 'cumulative' and even though the Duct technically also indirectly contains the FiberCables of the Innerduct, they will only be related to the Innerduct and not the Duct.

As an example, the illustration below shows that the Conduit contains one Duct that directly contains six FiberCables. In addition, the Duct also contains one Innerduct and that contains an additional three FiberCables.



The table below lists the data entities affected by use of this tool for these cases.

Operates on	Updates	Relationship Classes
FiberCable feature class	Ducts table	DuctHasFiberCable
	Innerducts table	InnerductHasFiberCable
		ConduitHasFiberCable

8. Items For Consideration

- If you want your data to be as absolutely accurate and representative of their real world locations as possible, FiberCables and Conduit vertices and edges should match exactly since the Conduit actually contains the FiberCable bundles. Use of other tools such as ArcGIS Schematics, can provide capabilities to visual these in an offset fashion without affecting the underlying data accuracy. However, if you require visualization of both Fiber Cables and Conduit in a single map view without the use of ArcGIS Schematics, you may wish to place the Fiber Cables at a slight offset from the Conduit when digitizing the features in ArcMap. The value of the offset should be determined based on the typical scale at which you would view these maps. This decision should be taken only after considering your mapping requirements and your organizations spatial data accuracy standards. Although it will result in less spatial data accuracy, it may well be within tolerable error values, depending on the map scale.