04a. Network dataset as a specific example of spatial data model

GE3238 GIS Design and Practices
Geography@NUS
Chen-Chieh FENG

Learning Objectives

- Is network dataset sufficiently general?
  - Entity, property, and relation
  - Relation between [entities | an entity and its property]
  - Current network (as in Lab01) to multi-modal network
- Spatial data models
  - Vector and raster: What do they offer?
  - The model to support network analysis?
    - Conceptual-logical-physical

Key terms

Spatial data model
Multimodal network

Current capabilities of the network (data) model in Lab01?

- Support applications that require optimizing distance travelled on restricted paths
- However, does it _____?
  - support accurate modelling of one-way
  - implement accurate modelling of one-way
  - support pedestrian movement as a model of travel
  - Implement pedestrian movement as a mode of travel
  - …

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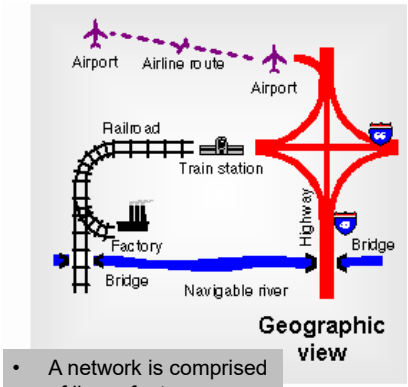
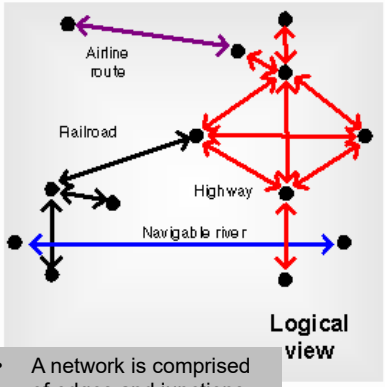


- A network is comprised of linear features through which commodities flow.
- A network contains point features where a transfer of commodities occur, such as from roads to railroad stations, or from one road to another.

Multi-modal network?

- What do you observe from the logical network in terms of **connectivity**?



- A network is comprised of edges and junctions.
- Commodities flow through edges, and edges connect together junctions, where flow from one edge to another.
- In a network, geometry is not important, only the connectivity of edges and junctions.

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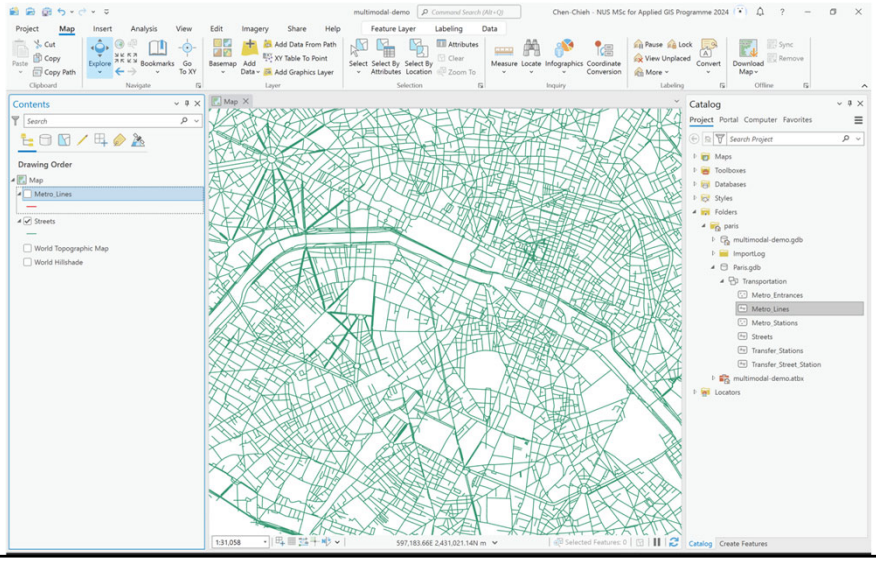
Street



Key terms

Logical & physical data model

Geometry

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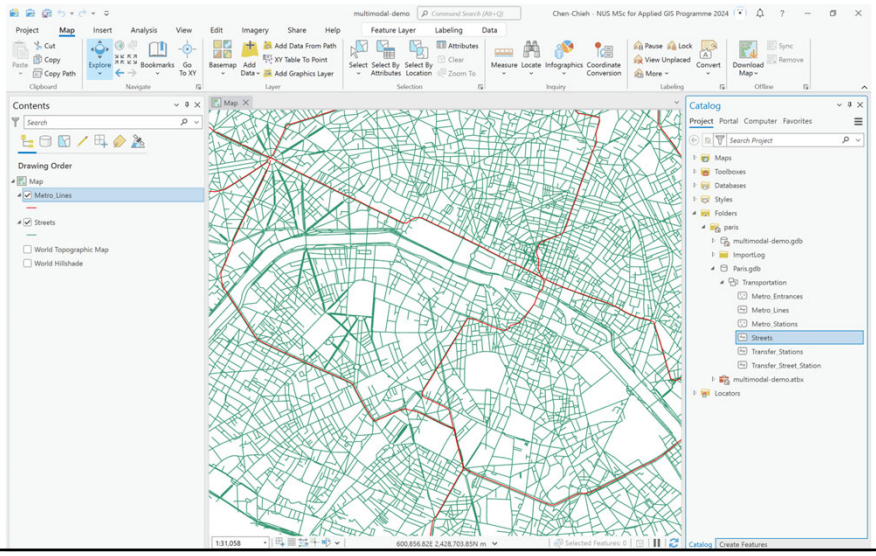
Street + Metro line



Key terms

Logical & physical data model

Geometry

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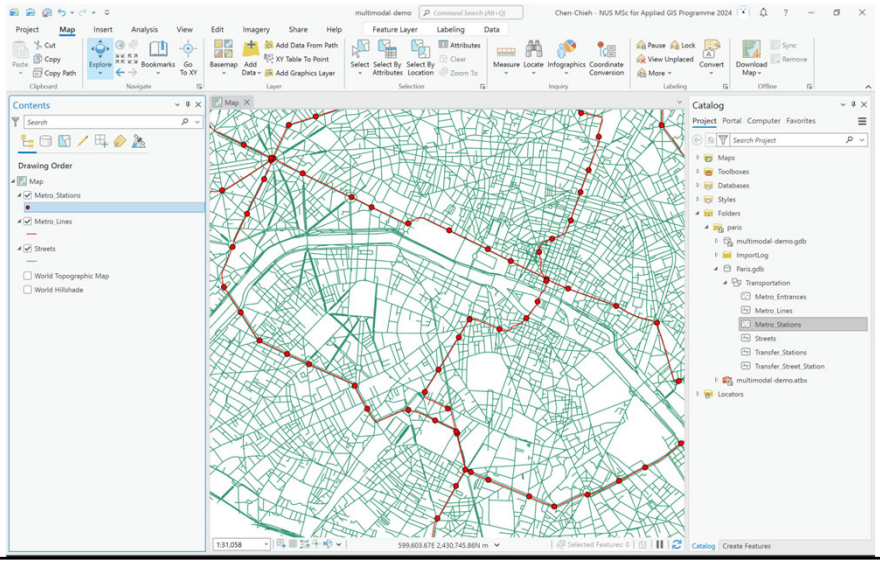
Street + Metro Line + Metro Station



Key terms

Logical & physical data model

Geometry

Junction

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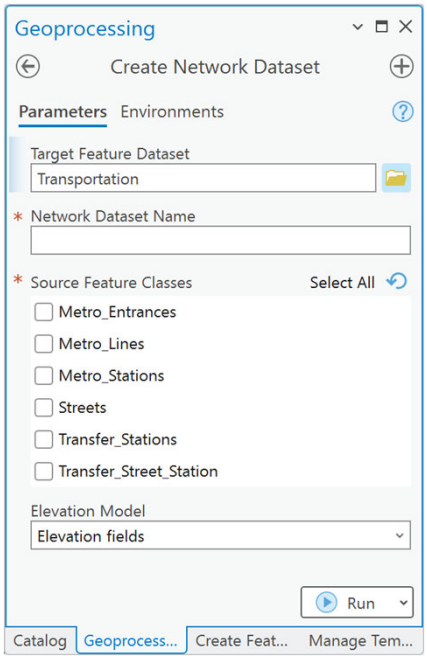
Multi-modal?

- "Multi-modal" in this lecture == multiple modes of transportation
- What data layers are needed for a multi-modal (transportation) network model?



Key terms

Multimodal

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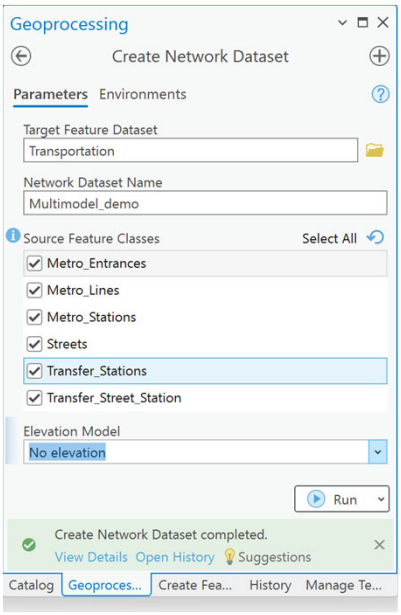
Multi-modal?

- By checking all six layers, what relations are implied?

(Implication – some of these relations must be specified to enable modelling of multimodal transportation network)



Key terms

Relation

Spatial relation

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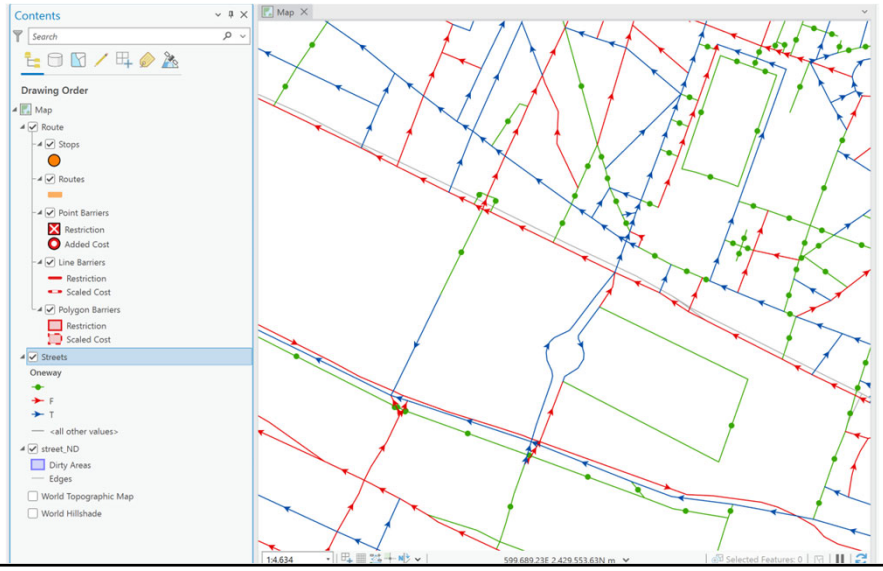
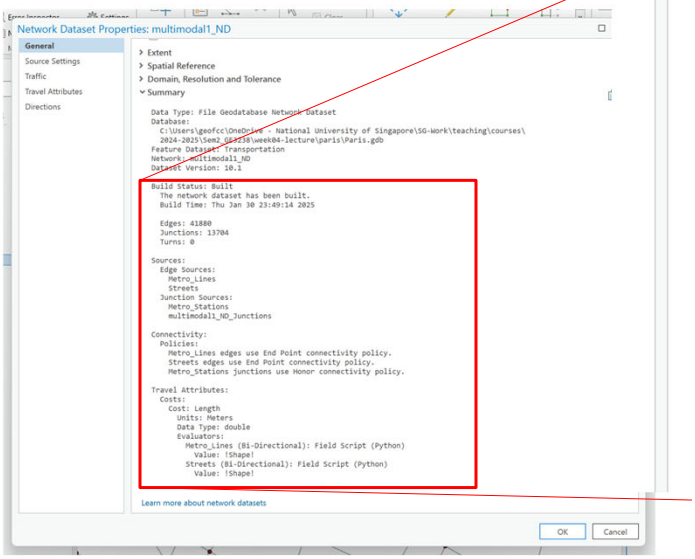
Visualizing Oneway field



Key terms

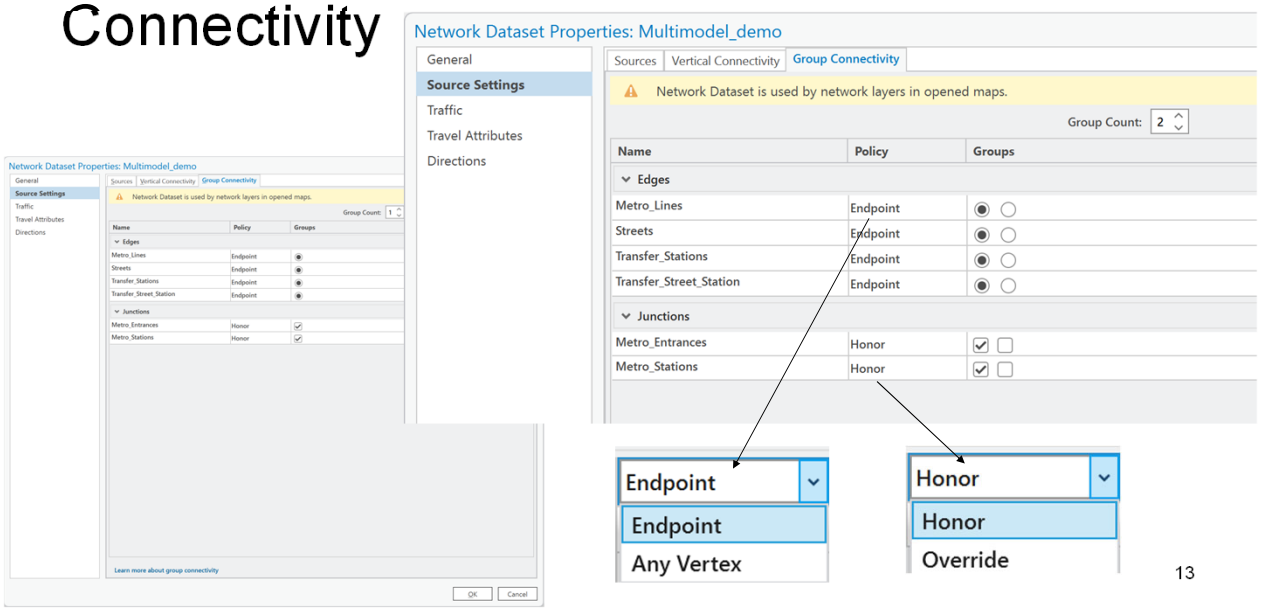
Symbology layer

What about the connectivity (up to this slide)?




```
Build Status: Built
  The network dataset has been built.
  Build Time: Thu Jan 30 23:49:14 2025

  Edges: 41880
  Junctions: 13704
  Turns: 0

Sources:
  Edge Sources:
    Metro_Lines
    Streets
  Junction Sources:
    Metro_Stations
    multimodal1_ND_Junctions

Connectivity:
  Policies:
    Metro_Lines edges use End Point connectivity policy.
    Streets edges use End Point connectivity policy.
    Metro_Stations junctions use Honor connectivity policy.

Travel Attributes:
  Costs:
    Cost: Length
      Units: Meters
      Data Type: double
      Evaluators:
        Metro_Lines (Bi-Directional): Field Script (Python)
          Value: !Shape!
        Streets (Bi-Directional): Field Script (Python)
          Value: !Shape!
```

Group Connectivity



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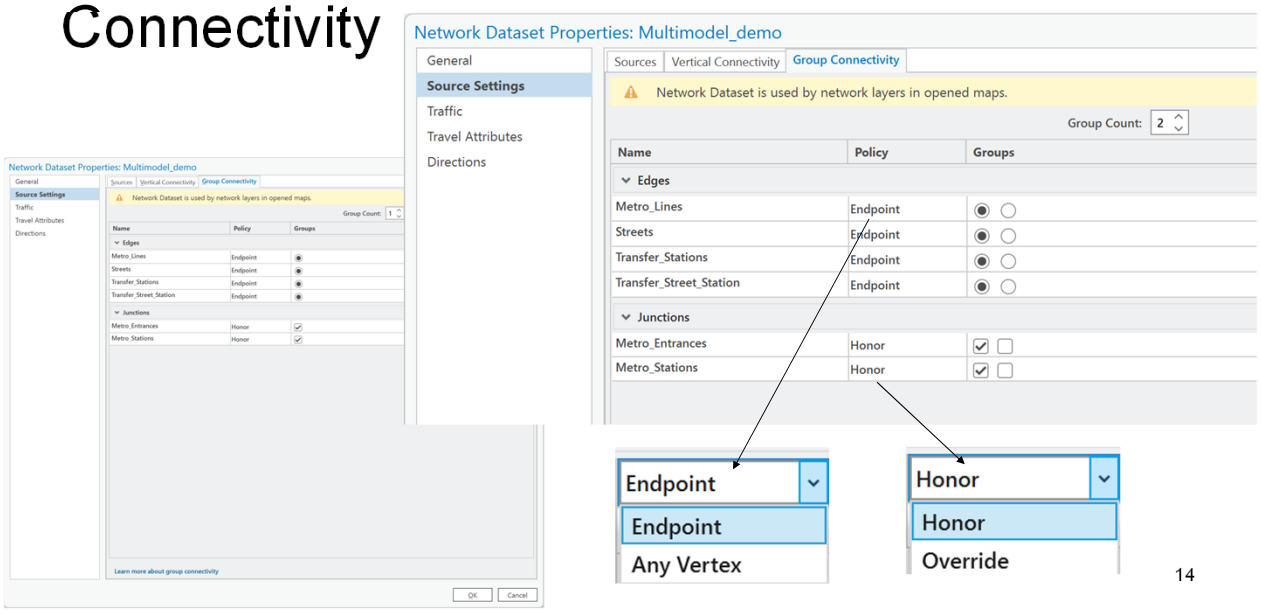
Group Connectivity



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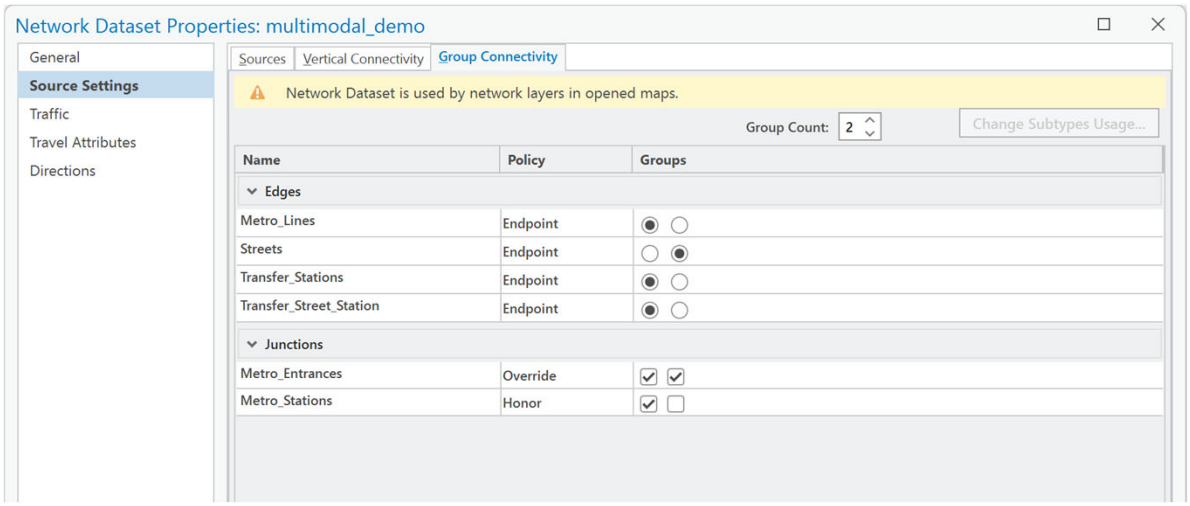
Group Connectivity



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Travel Attributes
Directions

```
Sources:
  Edge Sources:
    Metro_Lines
    Streets
    Transfer_Stations
    Transfer_Street_Station
  Junction Sources:
    Metro_Entrances
    Metro_Stations
    multimodal_demo_Junctions

Connectivity:
  Policies:
    Metro_Lines edges use End Point connectivity policy.
    Streets edges use End Point connectivity policy.
    Transfer_Stations edges use End Point connectivity policy.
    Transfer_Street_Station edges use End Point connectivity policy.
    Metro_Entrances junctions use Override connectivity policy.
    Metro_Stations junctions use Honor connectivity policy.
  Groups:
    1.
      Edges: Metro_Lines, Transfer_Stations, Transfer_Street_Station
      Junctions: Metro_Entrances, Metro_Stations
    2.
      Edges: Streets
      Junctions: Metro_Entrances

Travel Attributes:
  Costs:
    Cost: Length
      Units: Meters
      Data Type: double
      Evaluators:
        Metro_Lines (Bi-Directional): Field Script (Python)
          Value: !Shape!
        Streets (Bi-Directional): Field Script (Python)
          Value: !Shape!
        Transfer_Stations (Bi-Directional): Field Script (Python)
          Value: !Shape!
        Transfer_Street_Station (Bi-Directional): Field Script (Python)
          Value: !Shape!
```

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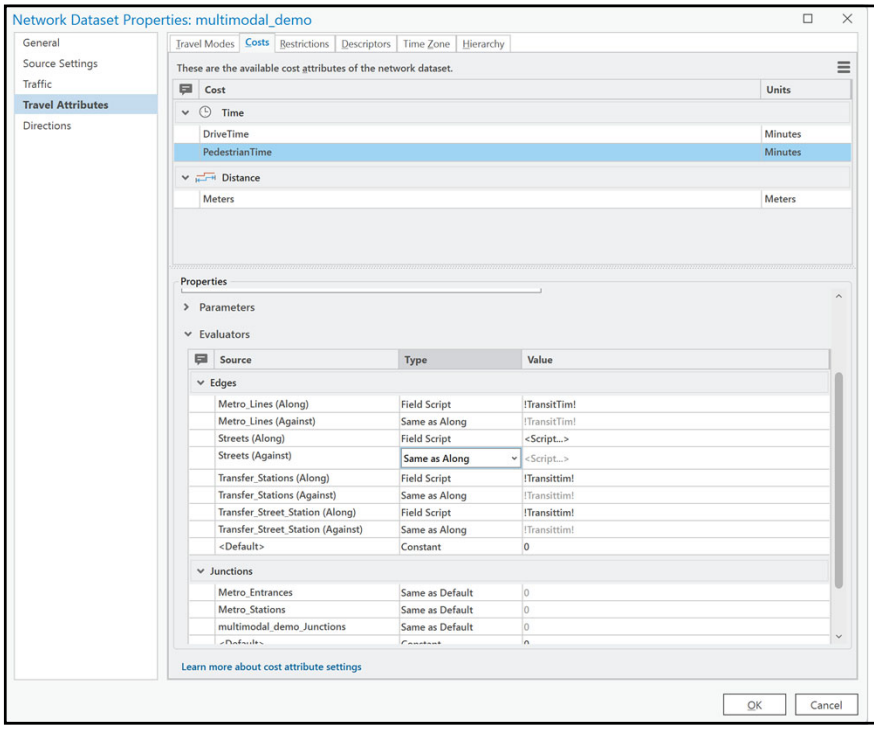

Key terms

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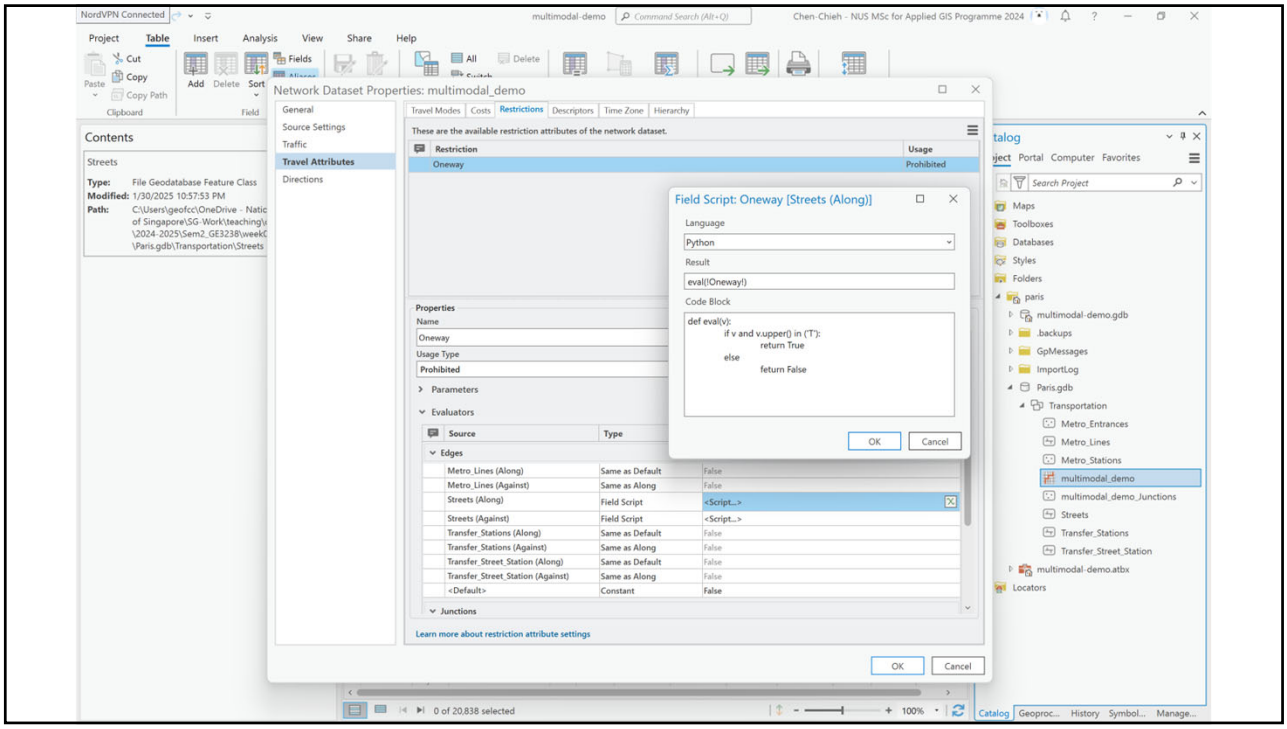

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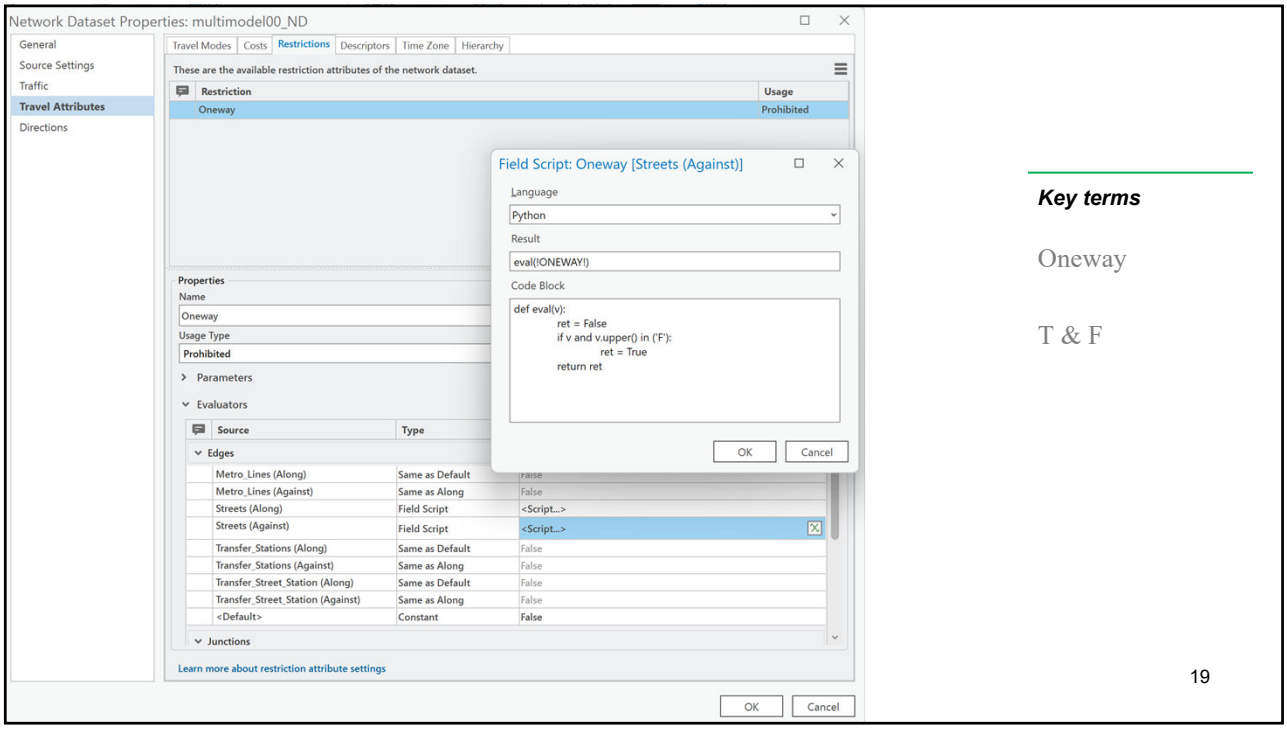

Key terms

Oneway

T & F

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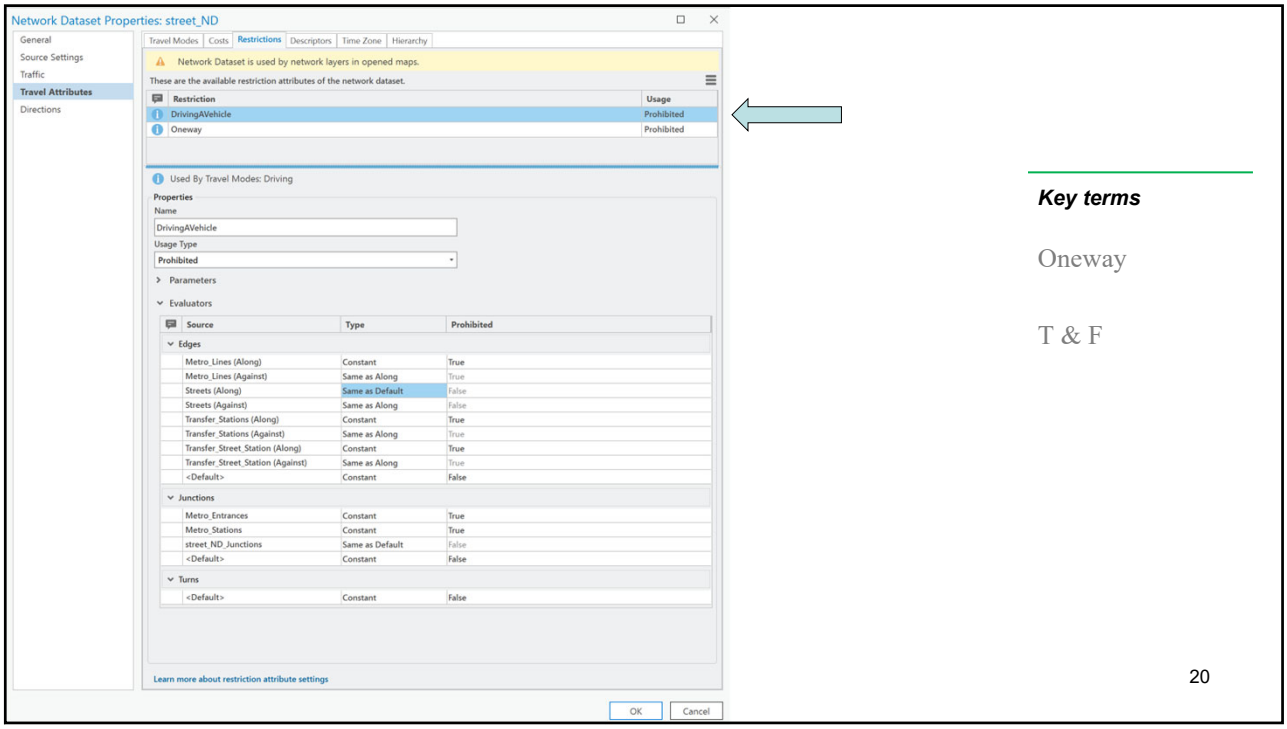

Key terms

Oneway

T & F

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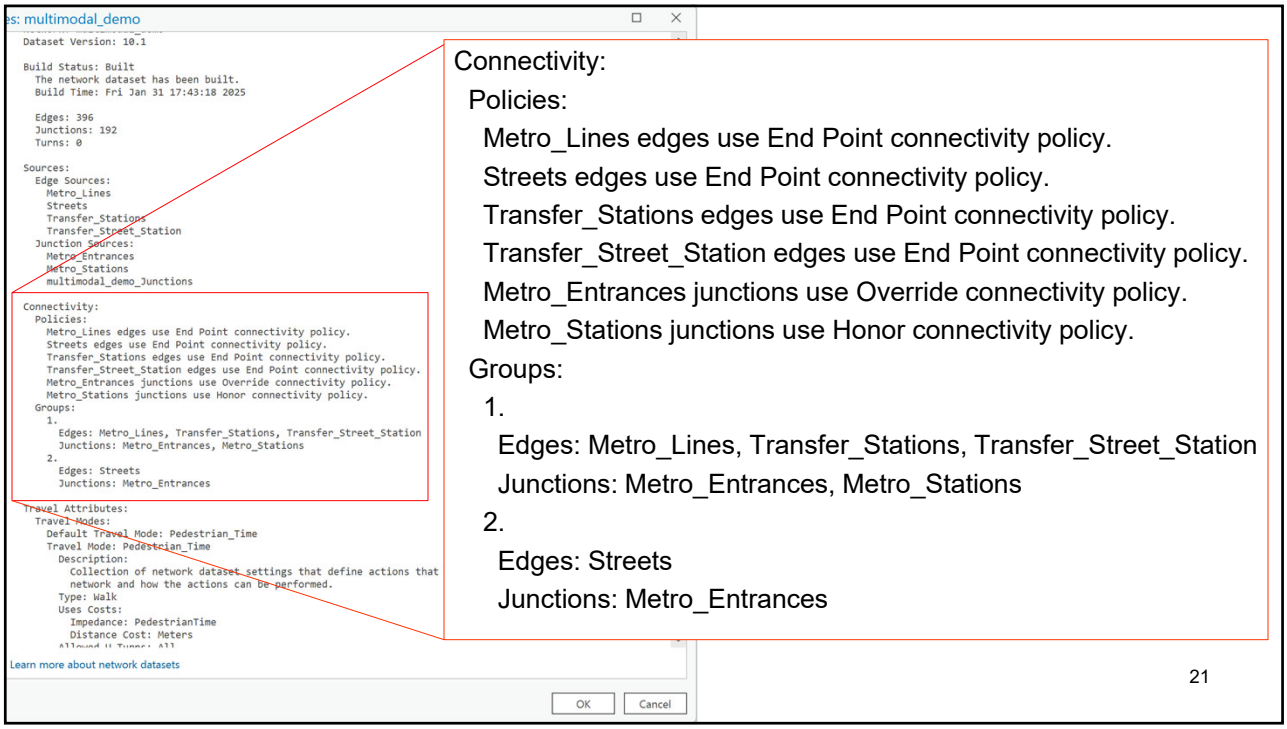

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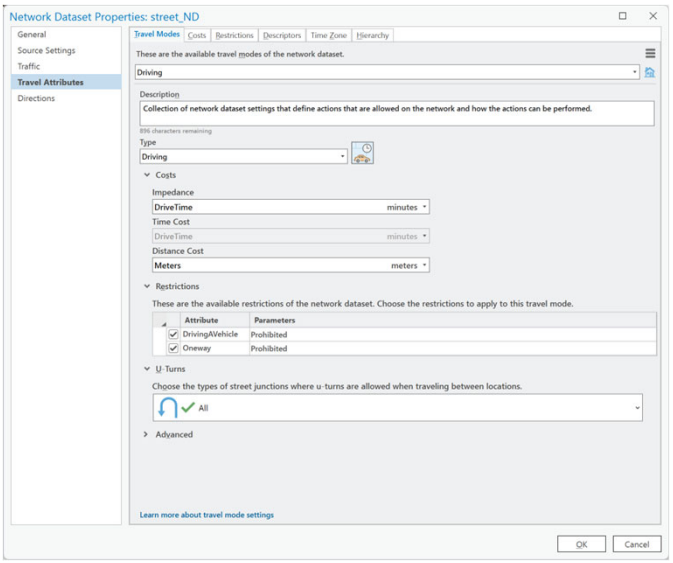
Travel Mode – Driving (in a multi-modal network)



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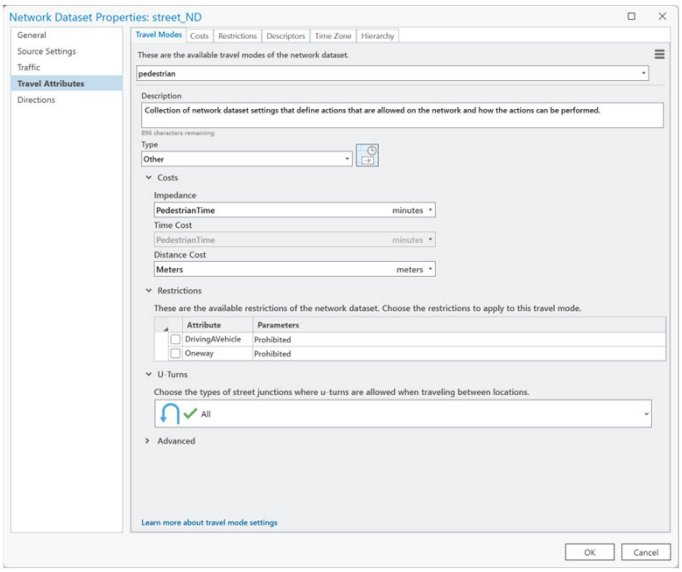
Travel Mode - Pedestrian



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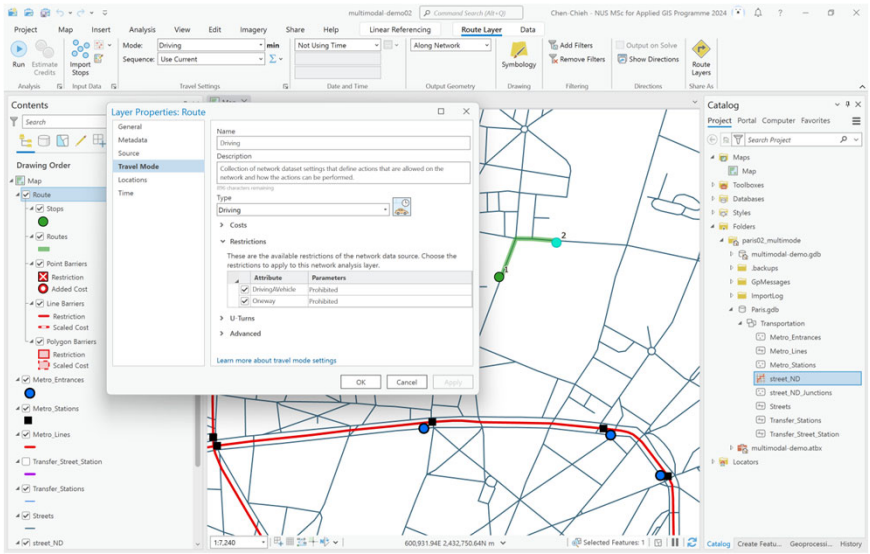
Verification - Driving



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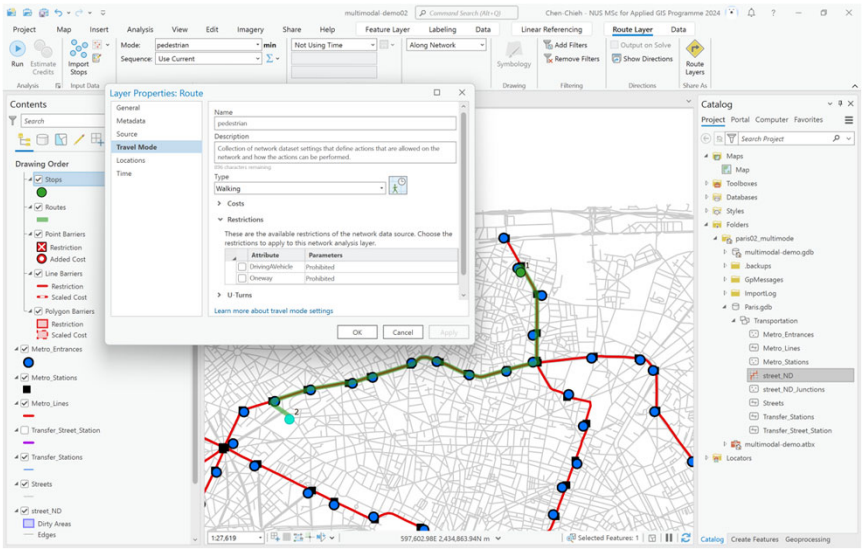
Verification - Pedestrian



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All is good…

- The Network dataset UI presents you the network data model for transportation
  - At the conceptual/logical level, it is a network
  - At the physical level, it uses a relational model
- It is sufficiently general
  - Versatility: supporting multi-modal transportation
  - Flexibility: allowing restrictions to be specified within multi-modal transportation

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All is good, but…

- Your data need to be clean with an appropriate topology
  - Mostly at end point
- We assume that data values are available in the attribute table
  - This is not always true
  - Values may carry different meanings
- Evaluator/restriction must be handled with care

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