Introducing Citilabs’ Scenario Based Master Network Data Model

FDOT Model Task Force Meeting

By

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Citilabs

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Agenda

- Introduction
- Master Network Concept
- Master Network Data Model
- Master Network Data Management
- Master Network Data Editing
- Master Network Editing in Multi-User Environment and Enterprise GIS
Introduction

Why Master Network?
- Problems with Scenario Based Network Storage
  - Data redundancy
- Problems with Scenario Based Network Editing
  - Cascading updates
- Problems with Scenario Based Network Data Management
  - Data security
  - Data replication

Data Format for Network Storage
- File based vs. database based
- Centralized storage vs. distributed storage
  - Data access issues
Master Network Concept

- **Unified data model for demand forecast modeling**
  - Standardized data definition for network data
  - Comprehensive data model to include all data objects for demand forecast modeling
  - Scalable data framework for transportation planning

- **Centralized database storage**
  - Single source of network for demand forecast modeling
  - Store data relationships between data objects
  - Eliminate data redundancy
  - Provide mechanism for cascading updates
  - Provide data management capabilities

- **Enabling Scenario Based Network Storage and Network Editing**
  - Define Data Scenario in database
  - Maintain relationships between scenarios
  - Track scenarios and scenario editing in data objects

- **Support Multiple Networks**
  - Support sub area networks
  - Support multi-type networks
    - Highway network
    - Transit network
    - Non-Transit network
    - Rail network
Master Network Concept (Cont’d)

- **Data Scenario in Master Network**
  - Highway Network Scenario
    - Scenario types
      - Year based: routine scenario, e.g., 2010 network, 2020 network
      - Project based: e.g., sub-area model network
      - Alternative: design scenario
    - Scenario changes
      - New roads
      - Change of existing roads
        - Reshape of road geometry
        - Split of existing roads
        - Attribute changes: e.g., number of lane change
  - Transit Network Scenario: similar to highway network scenario
    - Complexity of transit network scenario: multiple references (may have more than one parents), i.e., a transit network scenario may reference to base highway network or may reference to a highway network scenario?
  - Junction Scenario
    - Scenario types
      - Routine scenario: same as highway scenario
      - Attribute specific scenario
        - Different timing plan
        - Different lane geometry
        - Control type change: e.g., from two-way stop to fixed timing signal
    - Complexity of Junction scenario: similar to transit network scenario, a junction scenario may have more than one parents
Master Network Concept (Cont’d)

- **Relationships in Master Network**
  - Highway network
    - Has transit network
      - Has scenario
    - Has non-transit network
      - Has scenario
  - Has junction
    - Has scenario
  - Has volume

- **Other scenario based data**
  - Zonal data
Master Network Data Model

- **Master Network Definition**
  - Highway Network Definition
  - Transit Network Definition
  - Junction Definition
  - Volume Definition
  - Scenario Highway Network Definition
  - Scenario Transit Network Definition
  - Scenario Junction Definition
  - Scenario Volume Definition

- **Master Network Data Objects**
  - Highway network
    - Link
    - Node
  - Transit network
    - Line
    - Link
    - Node
  - Non-Transit network
    - Leg
  - Junction
    - Junction
    - Approach
    - Stage
    - Movement
    - Turn Penalty
  - Volume
    - Network volume
    - Junction volume
Other data objects in Master Network Data Model

- Zoning data
- Socioeconomic data
- Transit data
  - Timetable data
  - Frequency data
  - Trip data
- Matrix data
- Land use data
Master Network Data Model

- **Track Relationships between Network Data Objects**
  - Highway network – Transit Network relationship
    - SYNCTONETWORKID
  - Highway network – Junction relationship
    - NETWORKID
  - Base network – Scenario network relationship
    - NETWORK_ID
    - TRANSITGROUP_ID
  - Parent – Child relationships between scenarios
    - SOURCE_DATAID

- **Track Scenario and Scenario Editing in Data Objects**
  - Scenario identifier in Data Objects: DATA_ID
  - Scenario editing flags
    - Date Flags
    - Status Flags
### Highway Network Scenario Definition

<table>
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<tr>
<th>NETWORK_SCENARIO</th>
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### Junction Scenario Definition

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Tracking Scenario and Scenario Editing in Data Objects

<table>
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<th>HighwayNetwork_Link</th>
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<td>OBJECTID</td>
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<tr>
<td>SHAPE NETWORK_ID DATA_ID</td>
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<tr>
<td>A B</td>
<td>Scenario_Data_ID</td>
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<tr>
<td>DISTANCE ONEWAY FUNCLASS LANES RTENAME RTENUMB JURISDICT COUNTY FEDFUNC CITY AB</td>
<td>I3</td>
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<td>SOURCE_AB STATUS_CODE CASCADING_STATUS LAST_UPDATED UPDATED_BY DATE_INSERVICE DATE_OUTSERVICE_SHAPE_Length</td>
<td>Scenario_DataIDs</td>
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Scenario Identifier

Status Flags

Date Flags
Master Network Data Management

- Data Organization in Data Manager
  - Single parent tree structure
- Data Creation in Data Manager
- Data Copy
- Data Import/Export
- Data Access
Scenario Based Master Network Editing

- Scenario Network Data Editing Requirements in Demand Forecast Modeling
  - Be able to create scenario network data
  - Be able to display scenario network data
    - Display scenario relationships
    - Display scenario network on map
  - Be able to edit scenario network data
  - Be able to cascading network changes to related scenario networks
  - Be able to query scenario network data
Scenario Network Data Editing

- **Scenario Data Creation**
  - Network Scenario Creation
  - Junction Scenario Creation

- **Scenario Data Display**
  - Scenario Data Display in Data Manager
  - Scenario Data Display on map
    - Query layer of scenario data

- **Scenario Network Editing**
Highway Network Scenario Creation

Transit Network Scenario Creation

Junction Scenario Creation
How do you edit scenario network with Master Network now?

- **Separation of Master Network storage and editing from Cube environment**
  - Issues?
    - Keep sync from network changes in Cube to Master network?
    - How to maintain network topology if network is edited outside of Cube?
  - How to edit master network within Cube or Sugar?

1. **Store and Edit Master Network Outside Cube**
2. **Export to Scenario Network to Shape file**
3. **Load network shape file to model**
4. **Run model**

If network changed in Cube, how to sync back?
Scenario Network Editing in Future Cube and Sugar

- **Scenario Network Editing**
  - Editing query layer in ArcMap
  - Store scenario changes as new records in geodatabase
    - Store new network data entity
    - Store changed network data entity
      - Store geometry changes
      - Store attribute changes
      - Retire old network data entity
        - Set status to retired
        - Set DATE_OUTSERVICE
  - Store split link
    - Store split links as new links
    - Store Source_AB in new links for the parent link
    - Retire parent link
  - Store deleted network data entity
    - Set status to retired for the deleted link
    - Set DATE_OUTSERVICE
Scenario Network Data Editing (Cont’d)

- **Cascading Network Changes**
  - Cascading base network changes
    - Cascading changes for transit network
    - Cascading changes for junction: e.g., deleted node
      - Cascading changes for scenario junctions
    - Cascading changes for all scenario networks
  - Cascading source scenario network changes
    - Cascading changes for all child scenario networks

- **Cascading Network Changes Workflow**
  - Update Cascading_Status field
  - Highlight network changes in related networks
  - Allow options for automated cascading updates or manual updates
Master Network Editing with Enterprise GIS

- **What is Enterprise GIS?**
  - Centralized geodatabase to store scenario based network data
  - Allow multi-user access, edit geodatabase concurrently
  - Allow geodatabase versioning and edit versioned geodatabase
  - Allow geodatabase replication and synchronize distributed editing

- **Why enterprise GIS for Master network editing**
  - Single source of network
  - Multiple user access and editing
  - Protect network from unauthorized user
  - Support distributed editing
Multi-User Editing in Enterprise GIS

- **Enterprise GIS Database**
  - SQL Server
  - Oracle
  - DB2

- **Enterprise GIS Database Versioning**
  - Geodatabase Versioning
    - Default version: root version
    - Child versions
  - Version types
    - Protected version
    - Public version
    - Private version

- **Editing versioned geodatabase**
  - Register dataset as versioned dataset
  - Edit default version
  - Edit child versions
  - Compare changes in versions

- **Post versioned changes**
  - Reconcile conflicts
  - Post changes back to default version
Versioning Concept

Create Version

Edit Versioned Dataset Workflow

**Version Manager**

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<tr>
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<th>Owner</th>
<th>Access</th>
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<tr>
<td>ProjectA</td>
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<tr>
<td>DEFAULT</td>
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Compare version changes

To open the Version Changes dialog box, select a workspace from the source tab and click the Version Changes button on the Versioning Toolbar.

Total number of changes, in this case 7, broken down by feature class, then further into inserts, updates, and deletes.

Click an ObjectID to see its changes.

Changes that have been made to a version are shown in bold. This example shows a change in the BLPYTYPE field.

Clicking this will open the Version Changes display.
Multi-User Editing in Enterprise GIS

- **Multi-user Network Editing with Cube or Sugar**
  - Create versions for GIS group and Modeling group
    - Create private version
    - Only owner can edit
    - Administrator will do reconcile conflicts and post changes
  - Administrator or user creates SDE connection to a versioned network
  - Can create group of users to access versioned network
  - For a specific version, more than one user can access and edit the versioned network
  - Cube or Sugar can load versioned geodatabase to data manager and the map
Thank you!