

Introducing Citilabs' Scenario Based Master Network Data Model

FDOT Model Task Force Meeting

By

Minhua Wang, Ph.D.
Citilabs

November 9, 2009

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 scenario
 - ✓ Has volumn

❖ 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

Master Network Data Model (Cont')

❖ **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 Definition

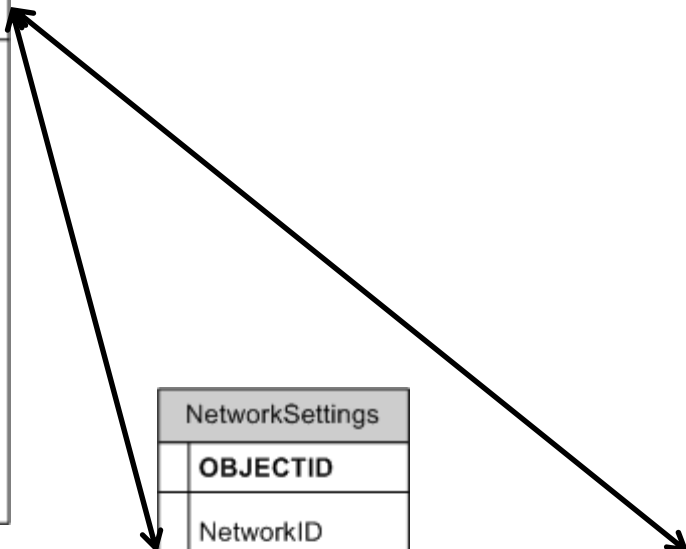
CITILABS_NETWORKS	
NETWORK_ID	
NETWORK_NAME	
NODE_FC	
LINK_FC	
CREATED_BY	
DATE_CREATED	
LASTUPDATE	
ZONES	
NODES	
LINKS	
HIGHESTNODE	
LEFTDRIVE	
PARENT_NETWORK	
DISTANCE_SCALE	
DESCRIPTION	

Transit Network Definition

CITILABS_TRANSITGROUPS	
TRANSITGROUP_ID	
TRANSITGROUP_NAME	
TRANSITGROUP_LINE	
TRANSITGROUP_LINK	
TRANSITGROUP_NODE	
CREATED_BY	
DATE_CREATED	
LASTUPDATE	
LINES	
NODES	
LINKS	
HIGHESTNODE	
PARENT_TRANSITGROUP	
TIMEFAC	
XYSPEED	
DESCRIPTION	
SYNCTONETWORKID	11
LASTSYNCDATE	

NetworkSettings	
OBJECTID	
NetworkID	
Units	
VolumeNames	
ShowAsNEMA	
ShowVoyOnly	
ShowPhaseClr	
IgnoreWarnings	
YellowTime	
AllRedTime	
Walk	
DontWalk	
HV	
PHF	
DefWidth	
DefFlow	
VehLength	
Growth	
PedSpeed	
LostTimeAdjust	
ScenarioDate	

Junction Definition



Highway Network Scenario Definition

NETWORK_SCENARIO	
PK	<u>NETWORK_ID</u>
PK	<u>DATA_ID</u>
	DATA_YEAR
	START_DATE
	END_DATE
	SCENARIOTYPE
	STATUS_CODE
	SOURCE_DATAID
	DESCRIPTION
	LAST_UPDATED
	UPDATED_BY

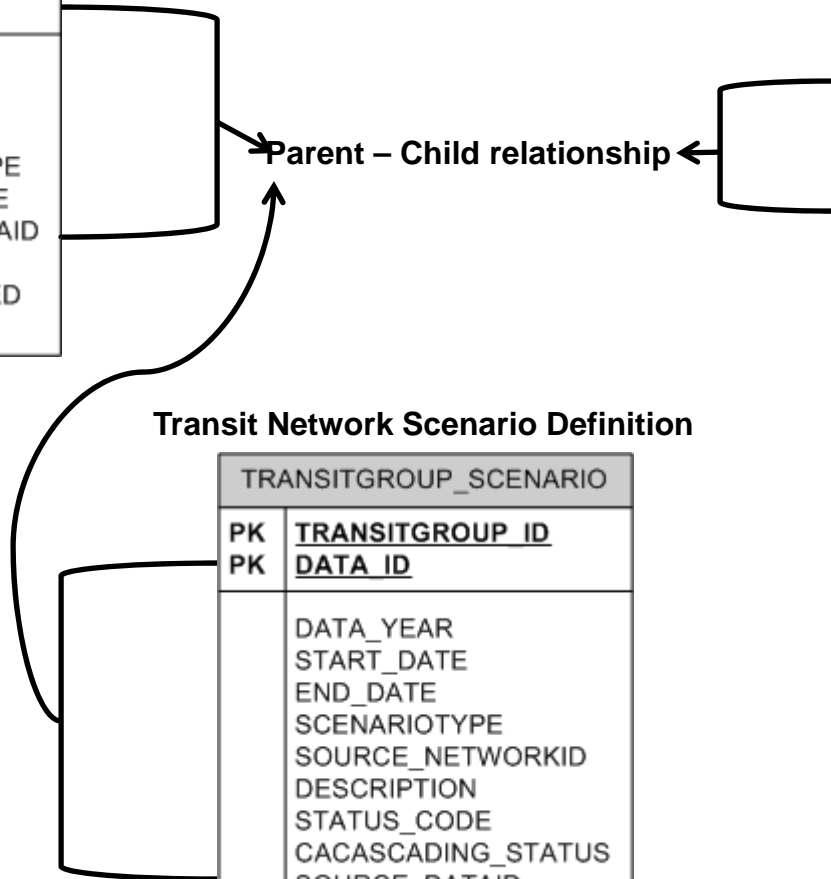
Junction Scenario Definition

JUNCTION_SCENARIO	
13	SOURCE_NETWORKID
11	SCENARIO_DATA_ID
	SCENARIO_NAME
	SOURCE_NETWORK_SCENARIO
15	SOURCE_NETWORK_DATAID
12	SOURCE_JUNCTION_DATAID
	LEVEL
14	STATUS_CODE
	CASCADING_STATUS
	DESCRIPTION
	DATE_UPDATED
	UPDATED_BY
	DATA_YEAR
	START_DATE
	END_DATE

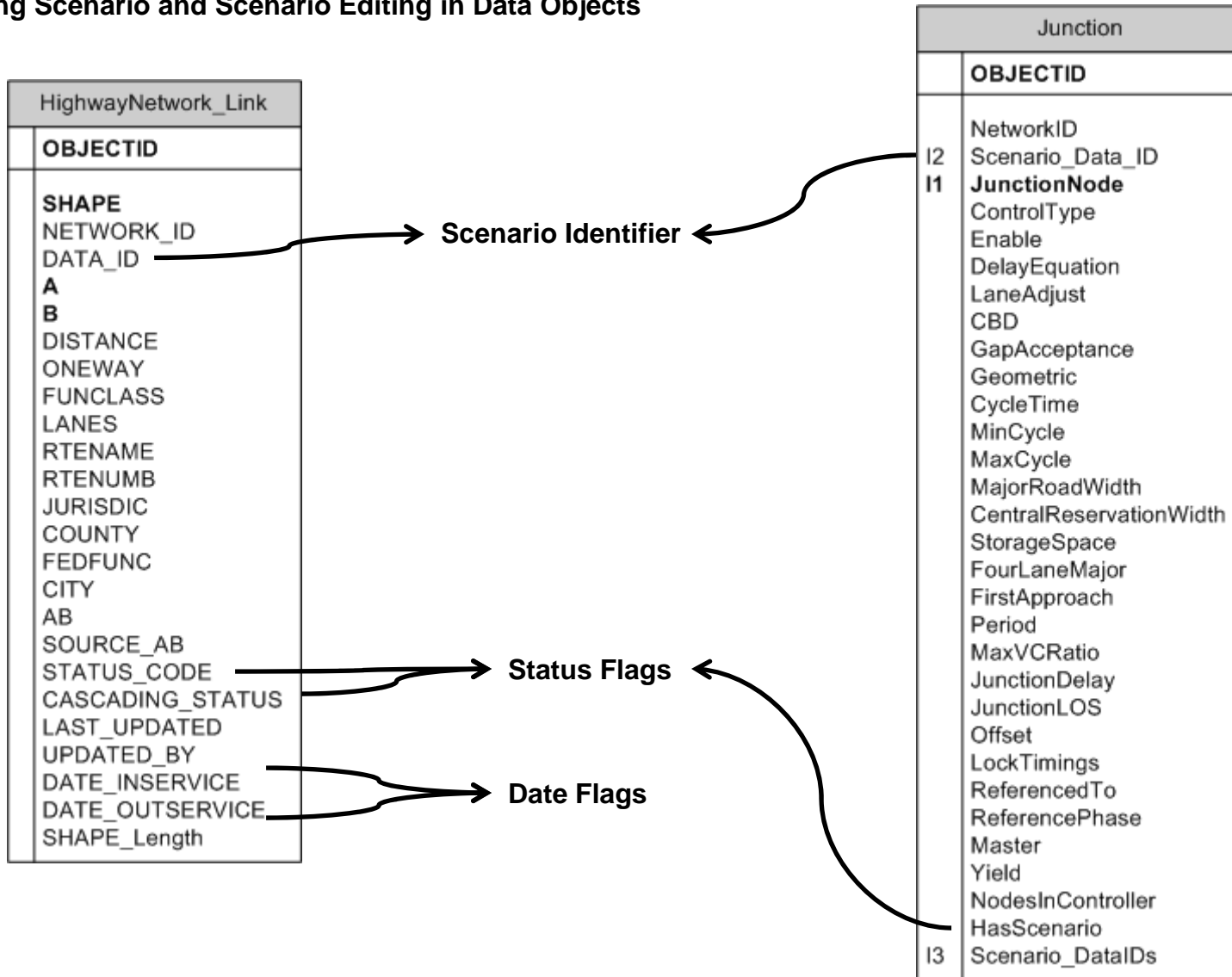
Transit Network Scenario Definition

TRANSITGROUP_SCENARIO	
PK	<u>TRANSITGROUP_ID</u>
PK	<u>DATA_ID</u>
	DATA_YEAR
	START_DATE
	END_DATE
	SCENARIOTYPE
	SOURCE_NETWORKID
	DESCRIPTION
	STATUS_CODE
	CACASCADING_STATUS
	SOURCE_DATAID
	LAST_UPDATED
	UPDATED_BY

Parent – Child relationship

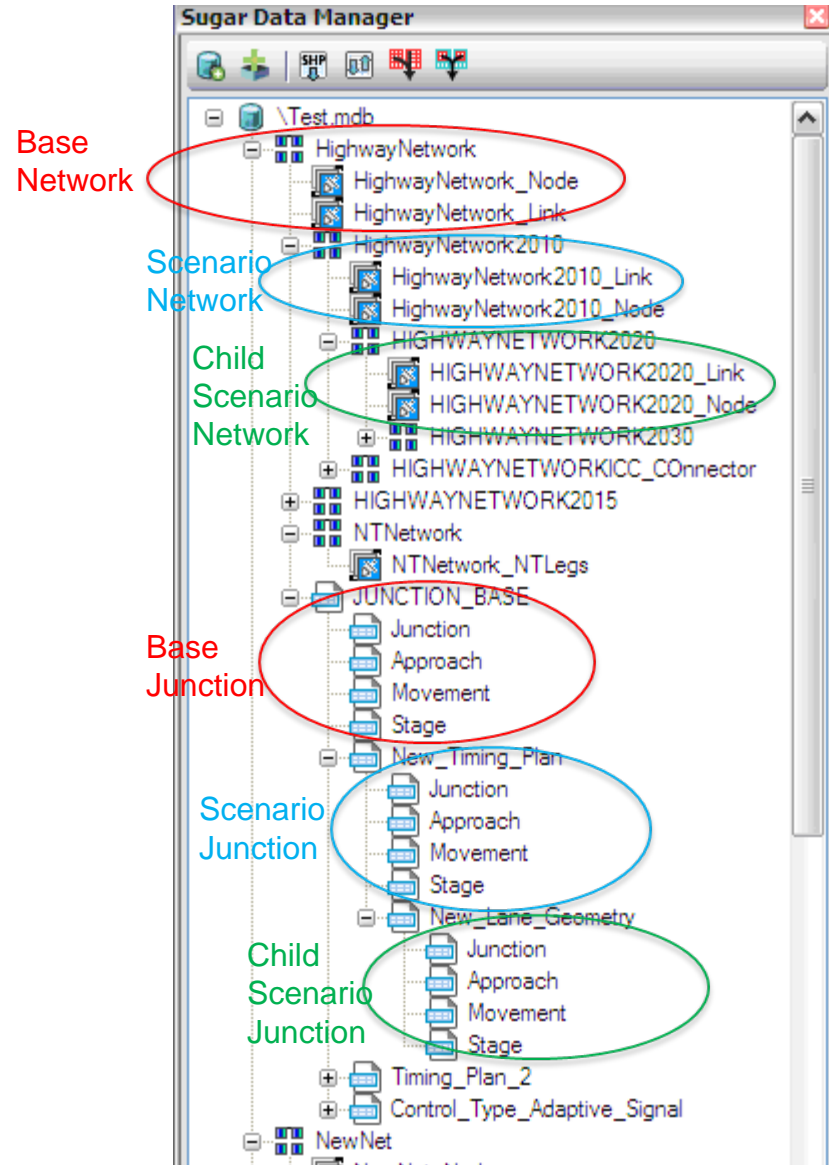


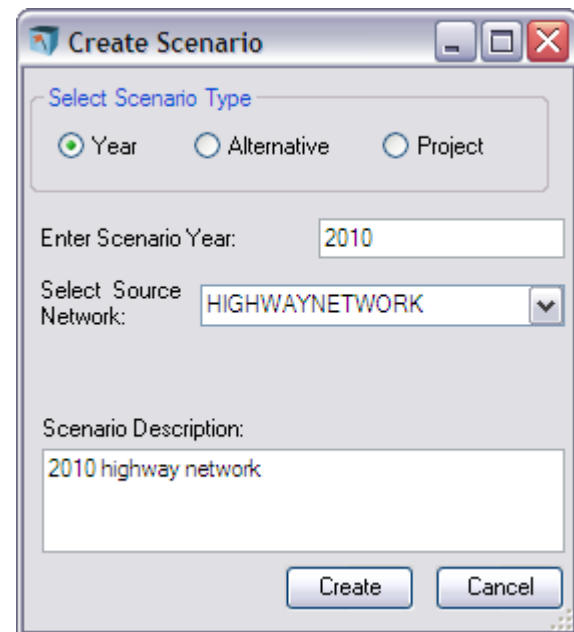
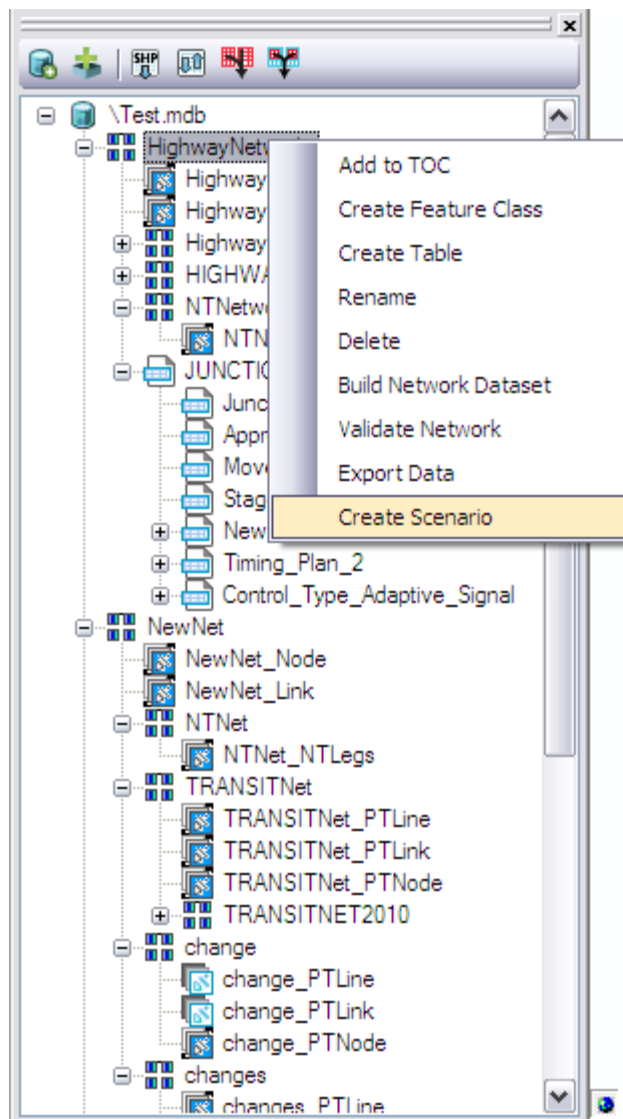
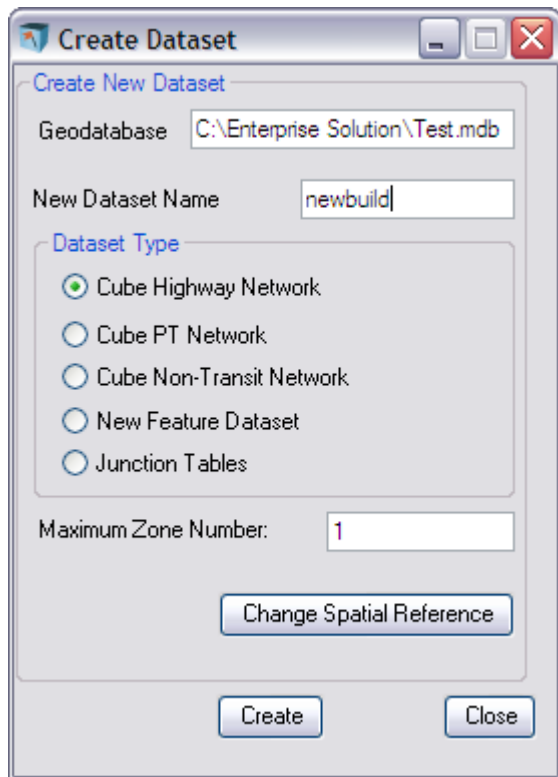
Tracking Scenario and Scenario Editing in Data Objects



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

Create Scenario

Select Scenario Type

Year Alternative Project

Enter Scenario Year:

Select Source Network:

Scenario Description:

Transit Network Scenario Creation

Create Scenario

Select Scenario Type

Year Alternative Project

Enter Scenario Year:

Select Source Network:

Select Source PT Network:

Scenario Description:

Junction Scenario Creation

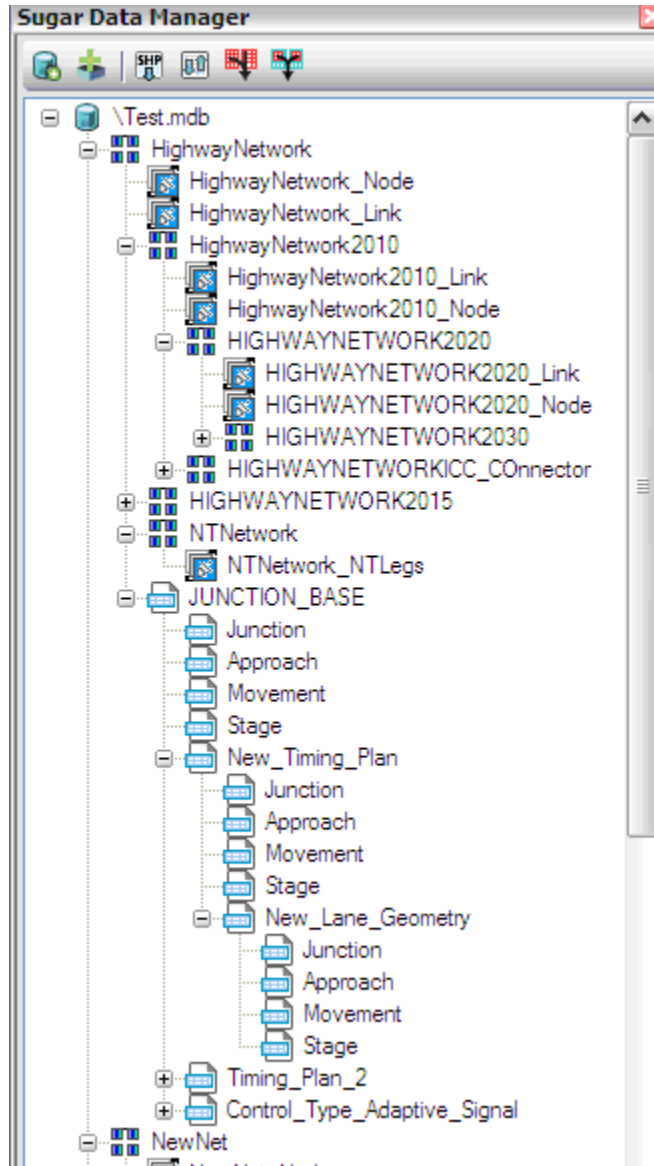
Create Junction Scenario

Scenario Name:

Select Source Network:

Select Source Junction (including Junction Scenario):

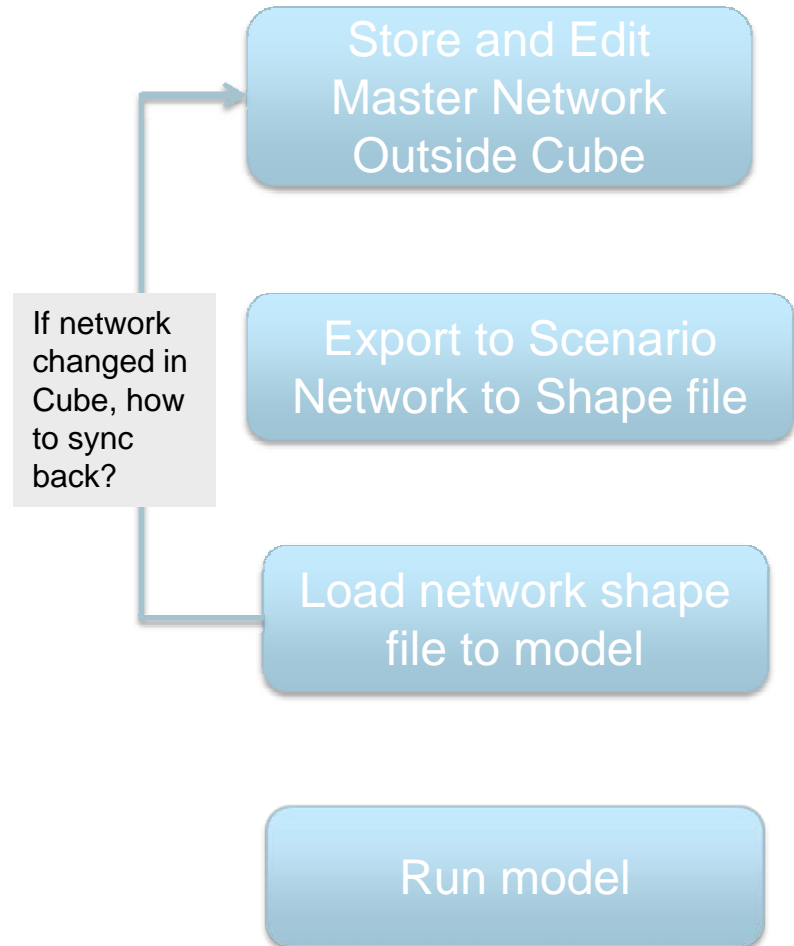
ScenarioDescription



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?



Scenario Network Data 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

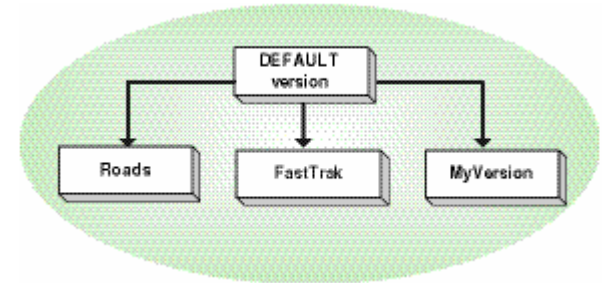
❖ **Why enterprise GIS for Master network editing**

- 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

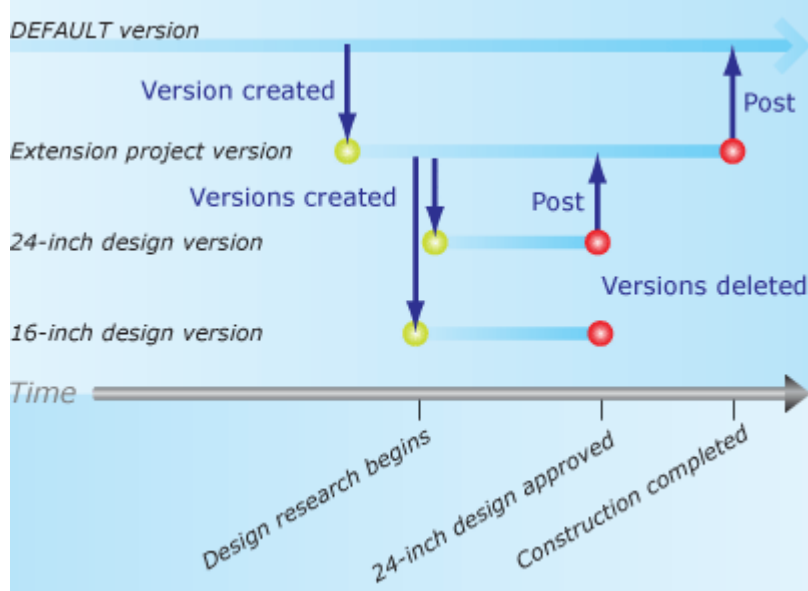
Versioning Concept



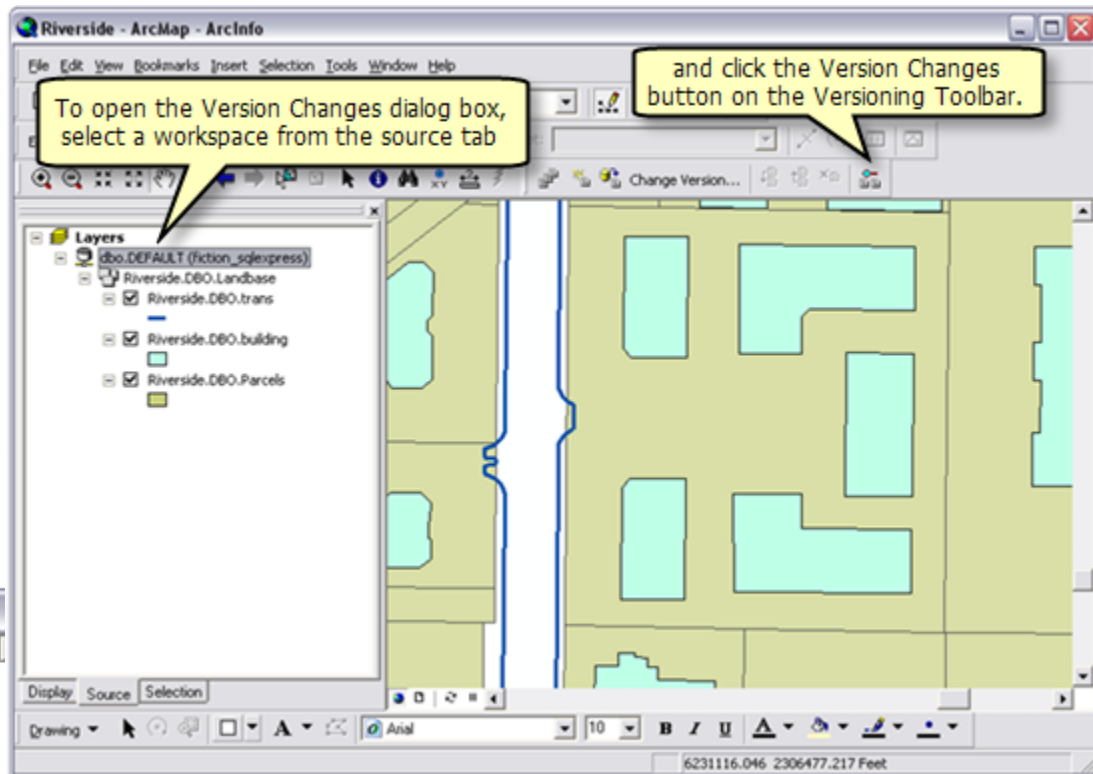
Create Version

Name	Owner	Access
ProjectB	"ROCKETJAY\PLLAMA"	Public
ProjectA	"ROCKETJAY\SASHA"	Public
QA	DBO	Public
DEFAULT	dbo	Protected

Edit Versioned Dataset Workflow



Compare version changes



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.

Version Changes

- Changes (7)
 - RIVERSIDE.DBO.BUILDING (7)
 - Inserts (1)
 - Deletes (1)
 - Updates (5)
 - 4435**
 - 6622
 - 6612
 - 6252
 - 6224

OBJECTID	AREA_	PERIMETER	BLD_DISS_I	BLPYTYPE	GLOBALID	SHA	SHA
4435				2	{32C6E540-B0C6-4...		
6622				1	{32C6E540-B0C6-4...		
6612				1	{32C6E540-B0C6-4...	20247.0593165692	601.426010137486
6252							
6224							

Change Display >>

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!

