Introduction To CUBE 2023 (7)

Ohio DOT

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Advancing Infrastructure

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CUBE
Predictive modeling and simulation of transportation

EMME®
Multimodal transport planning

LEGION®
Improving infrastructure for people

DYNAMEQ®
Traffic simulation and dynamic traffic assignment

CityPhi
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AGENT
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What is CUBE 2023 (formerly 7)?

- CUBE 2023
  - is a significant re-engineering of CUBE 6
  - takes the best ideas from CUBE 6 and built it on modern technology
    - Application flowchart
    - Scenario management
  - is built for handling larger data with better performance
  - uses modern data formats
  - is not an upgrade to CUBE 6
  - does not include updates to the modeling engine
    - Voyager*, Avenue, Land, Cargo, Analyst Drive

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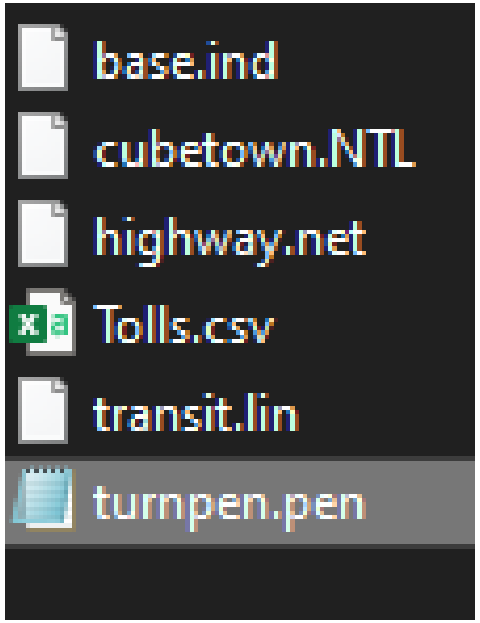
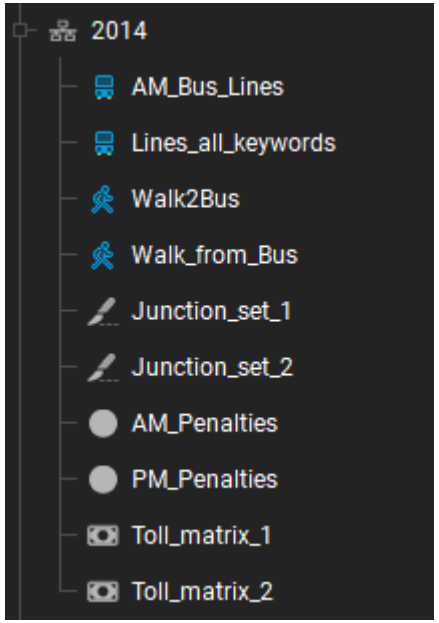
Database/Network

- Cube 2023 uses a new database format
- Synchronized network components
- Supports all network data
- Supports point/polyline/polygon feature classes
- Supports data tables





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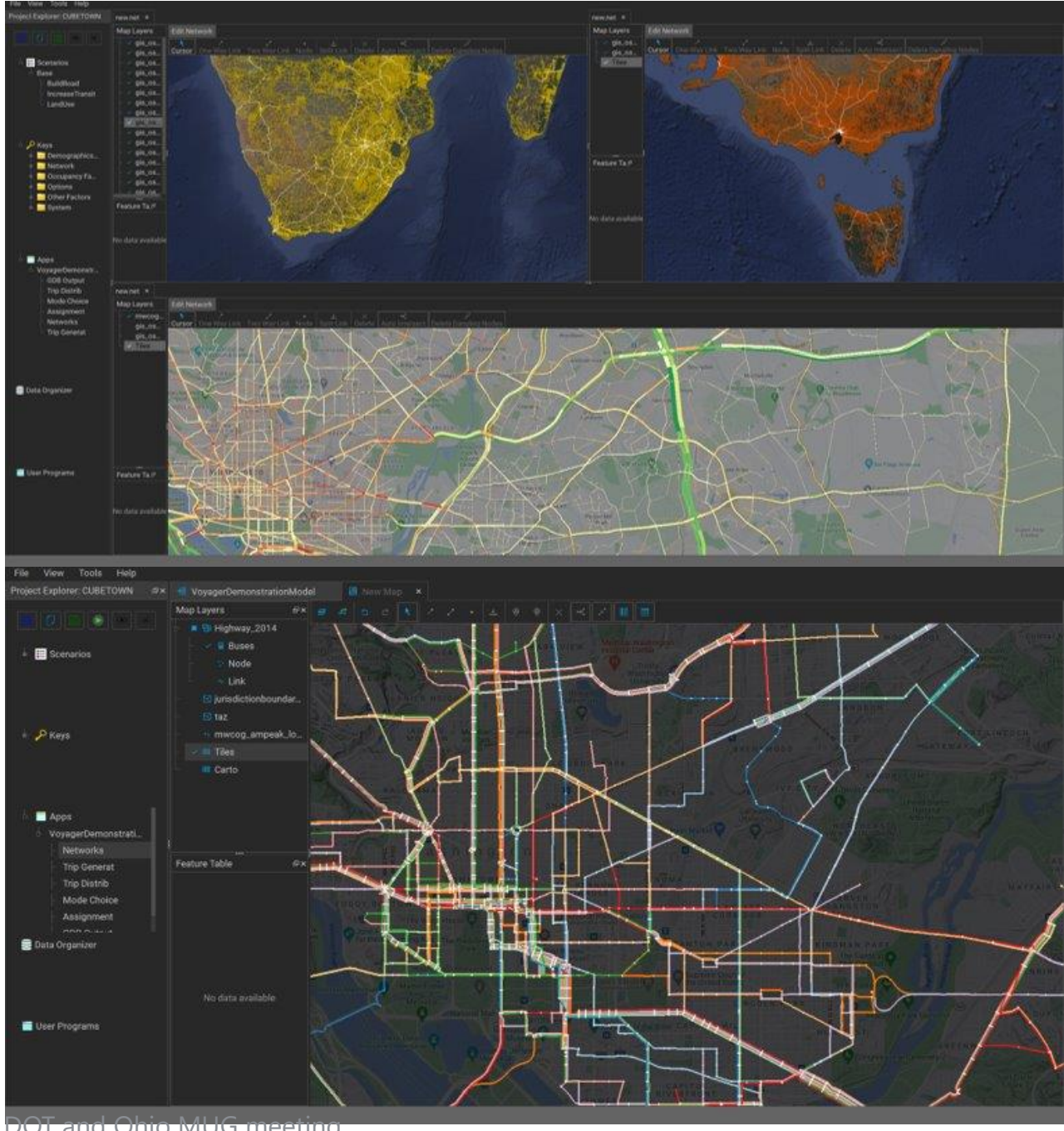
GIS

- Not dependent on ArcGIS
- Built to handle large datasets
- Bing base maps by default
- Runs on GPU
- Supports powerful expressions
  - E.g., __transitLineCountByNetwork[AM_Bus_Lines] > 0



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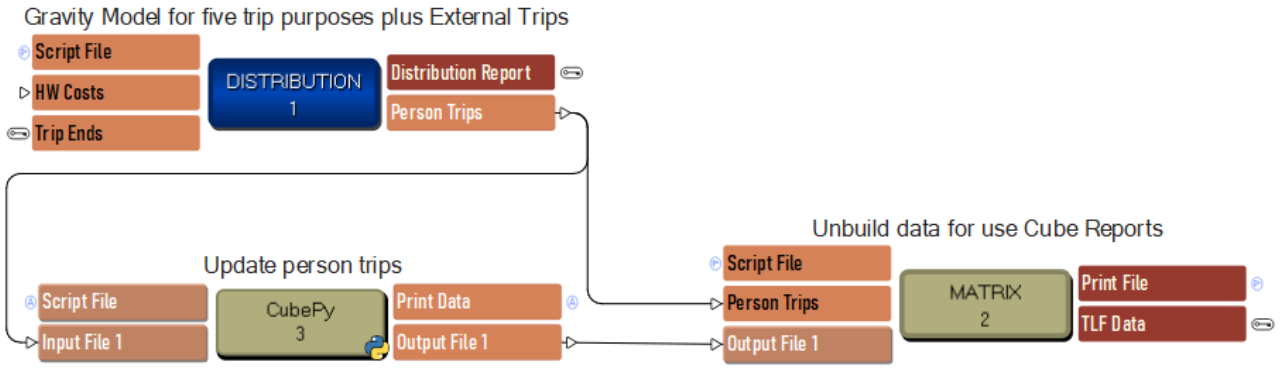
CubePy

- Python API which provides powerful methods for network and matrix processing.
- GIS Network editor is based off CUBE API, any workflows/tasks you can achieve in the GIS editor, can be scripted using CubePy.
- Can easily integrate CubePy into their existing model applications (Voyager) through the built in CubePy program box.

```python
import os
import contextlib
import math
from pathlib import Path
import shutil
import cubeapi as cp

# This example takes an input Cube Database that has
# has been created previously and performs various
# operations on it. Note, it makes a copy of the
# original Spatialite file.

if __name__ == "__main__":
    data_dir = f"{Path.home()}/data/cube7_test_data"
    output_dir = "output"
    source_db = f"{data_dir}/cube7_networks/jacksonville_cubedb.sqlite"
    network_name = "test_network"
    link_count = 10000
    working_db = f"{output_dir}/jacksonville__misc_processing_cubedb.sqlite"

    # copy the source db to a working db we will modify
    with contextlib.suppress(FileNotFoundError):
        os.remove(working_db)
    shutil.copyfile(source_db, working_db)

    # database already exists
    db = cp.CubeDatabase(working_db)

    # get the network names and list them
    networks = db.getNetworkNames()
    print("Networks: ")
    for index in range(len(networks)):
        print(f"\t{index + 1}: {networks[index]}")

    # get the first network name
    network_name = networks[0]

    # We can find intersecting links for a geometry.
    wkt = "LineString(-81.46282999978468468 30.6774699996487989, -81.45469999998580298 30.67027999992210141)"
    # This returns a list of LinkGeometryEntry with "a", "b", and "wkt"
    links = db.getLinkIntersectionForGeometry(network_name, wkt)
    print("<===> Finding links that intersect with the following geometry:")
```



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Click and Run tools

- Cube toolbox provides Click and Run tools to accomplish tasks without scripting
- Users can create their own tools to share with other users

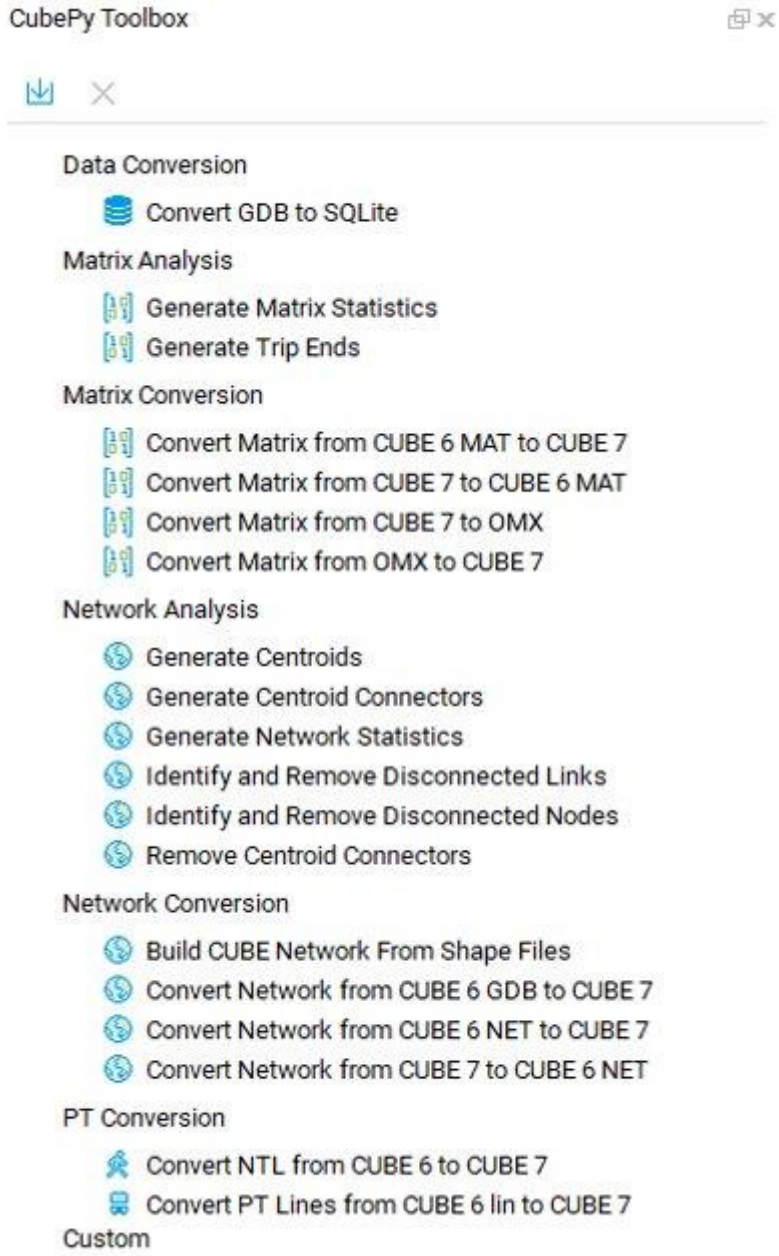

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Table Editor

- New table/matrix editor to handle large data
- Supports csv editing
- New matrix format based on the hdf5 format
- Support for SQL queries

	TAZ	WORKP	CHOOLI	SHOPP	THERP	NHOMI	TERNAI	TOTALP	WORKA	CHOOL	SHOPA	THERA	NHOMI	TERNAI	TOTALA
1	1	4,619	1,455	3,844	11,021	4,145	0	30,766	1,377	959	2,174	5,199	4,145	7,736	21,589
2	2	2,799	867	2,277	6,060	4,714	0	17,834	1,749	698	1,654	4,943	4,714	7,677	21,428
3	3	1,417	441	1,195	3,353	1,609	0	9,445	605	339	775	1,922	1,609	2,931	8,181
4	4	3,737	1,610	2,944	8,455	8,072	0	24,798	4,139	1,726	3,918	9,423	8,072	15,232	42,509
5	5	546	156	546	1,366	5,397	0	3,902	3,818	675	1,633	5,007	5,397	9,231	25,761
6	6	2,661	1,592	1,927	5,117	15,567	0	16,915	9,154	2,359	5,573	15,792	15,567	27,019	75,464
7	7	2,421	875	1,913	5,290	3,442	0	15,633	1,978	734	1,665	3,982	3,442	6,590	18,390
8	8	3,078	1,005	2,500	6,916	3,739	0	20,084	1,303	726	1,677	4,350	3,739	6,587	18,383
9	9	2,759	708	2,299	6,356	6,142	0	17,917	2,938	1,145	2,644	6,838	6,142	11,005	30,712
10	10	2,362	762	1,895	5,095	3,422	0	15,114	1,096	522	1,249	3,679	3,422	5,566	15,533
11	11	4,359	1,729	3,491	9,644	5,740	0	28,627	1,900	925	2,194	6,274	5,740	9,511	26,544
12	12	411	120	346	932	1,528	0	2,691	668	209	506	1,543	1,528	2,487	6,941
13	13	849	246	720	1,975	8,345	0	5,610	4,244	698	1,855	7,922	8,345	12,544	35,008
14	14	2,820	824	2,352	6,685	4,369	0	18,650	1,470	671	1,602	4,684	4,369	7,142	19,938
15	15	2,943	744	2,429	7,114	4,853	0	19,305	1,933	782	1,848	5,226	4,853	8,176	22,817
16	16	1,389	339	1,139	3,083	2,263	0	8,845	737	305	745	2,339	2,263	3,567	9,956
17	17	0	0	0	0	0	24,000	24,000	0	0	0	0	0	0	0
18	18	0	0	0	0	0	26,000	26,000	0	0	0	0	0	0	0
19	19	0	0	0	0	0	30,000	30,000	0	0	0	0	0	0	0
20	20	0	0	0	0	0	22,000	22,000	0	0	0	0	0	0	0
21	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	23	0	0	0	0	0	7,000	7,000	0	0	0	0	0	0	0
24	24	0	0	0	0	0	12,000	12,000	0	0	0	0	0	0	0
25	25	0	0	0	0	0	18,000	18,000	0	0	0	0	0	0	0

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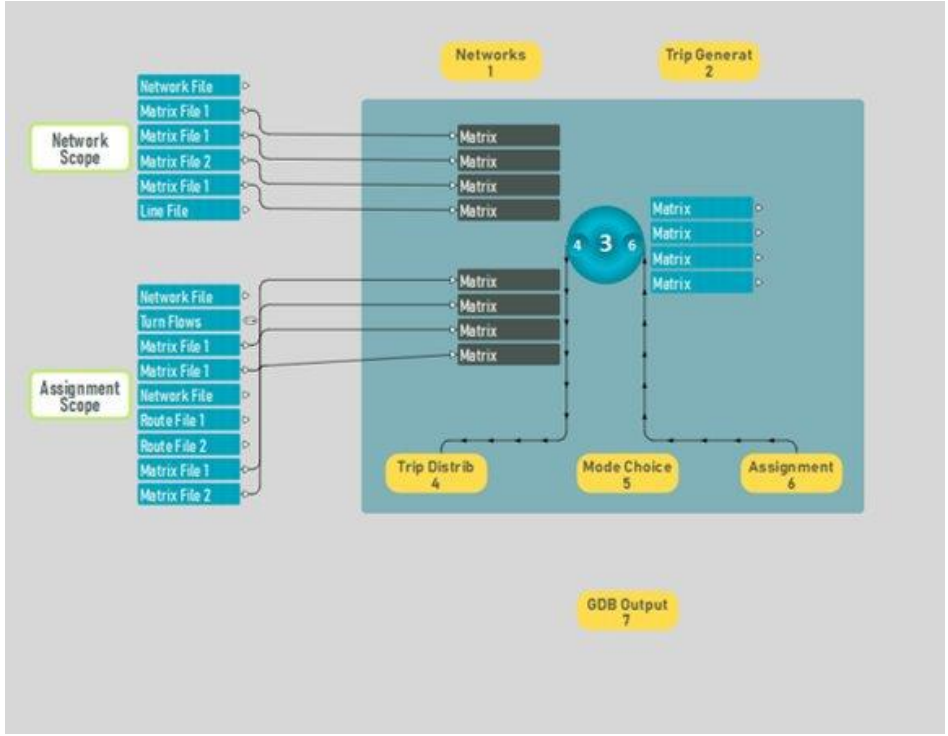
Application Editor (Flow Chart)

- Application Manager has a new look and have more powerful visual capabilities such as:
  - Zooming / scaling,
  - Application navigation view
  - Ability to view the entire application group tree hierarchy and navigation
- Edit history and undo / redo
- Users will have more control over model design e.g., how far up a group hierarchy that an input file may be "public“
- Model run mode; AM will allow running of an application and all of its subgroups in a read-only view that highlights the currently running program and various statistics about the current run (similar to Task Monitor but more detailed)



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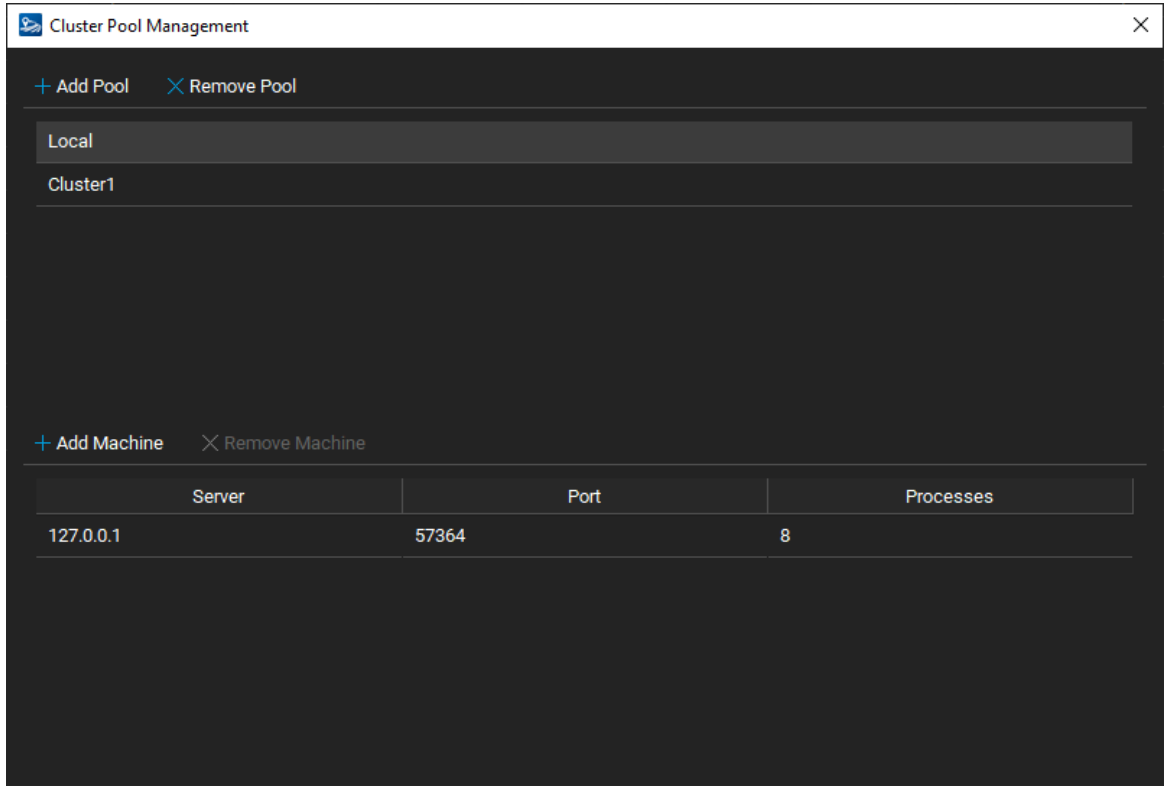
Cube Cluster

- Much greater usability and manageability
- Based on a robust client-server protocol system rather than file based inter-process communication
- Consolidated and centralized cluster node management
- Automatic determination of nodes to assign for a particular Multistep or Intrastep
- Ability to manage multiple CUBE Cluster compute pools from one interface / client (i.e., multiple model runs could be started and monitored from one user interface even



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Other improvements

- Multi version support
- Windows/tab management
- Relative file references to better support version control like Git
- JSON format application and project files (catalog files)

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Things to know

- CUBE 6 models must be converted to CUBE 2023
  - Catalogs/Applications
  - Network data
  - Cluster scripts
  - Pre/Post-Processing steps
- Built in tools available
- Junction/turn penalty GUI editor available for future release

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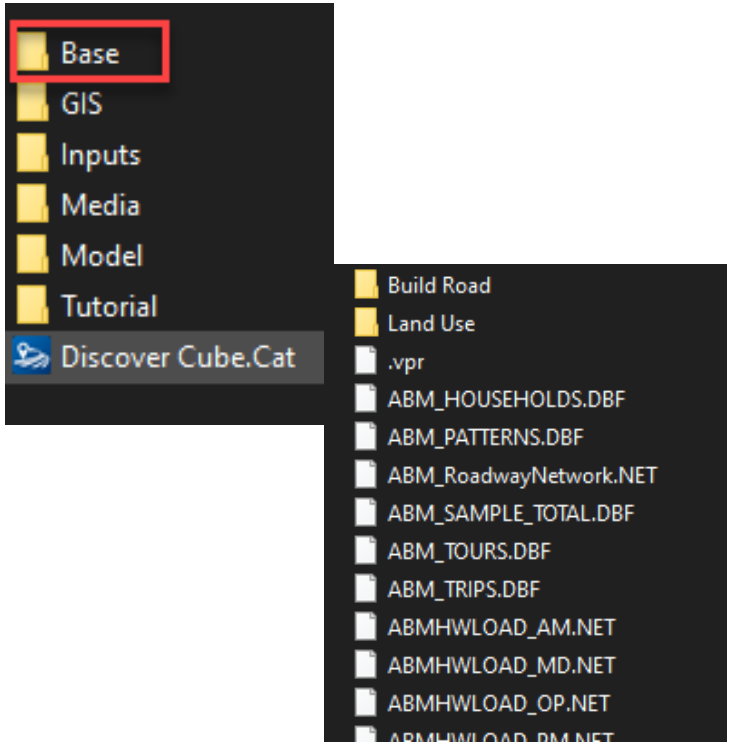
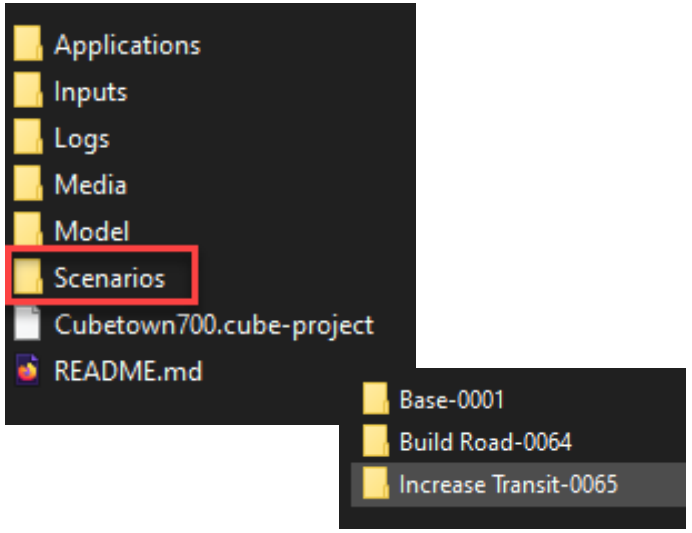
Scenarios

- A flat folder structure with scenario code to identify scenarios

CUBE 6



CUBE 2023



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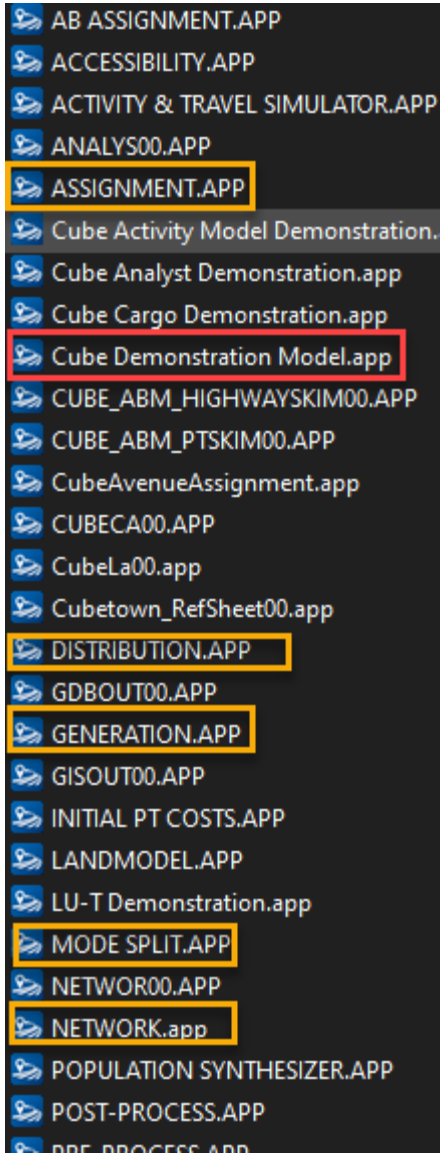
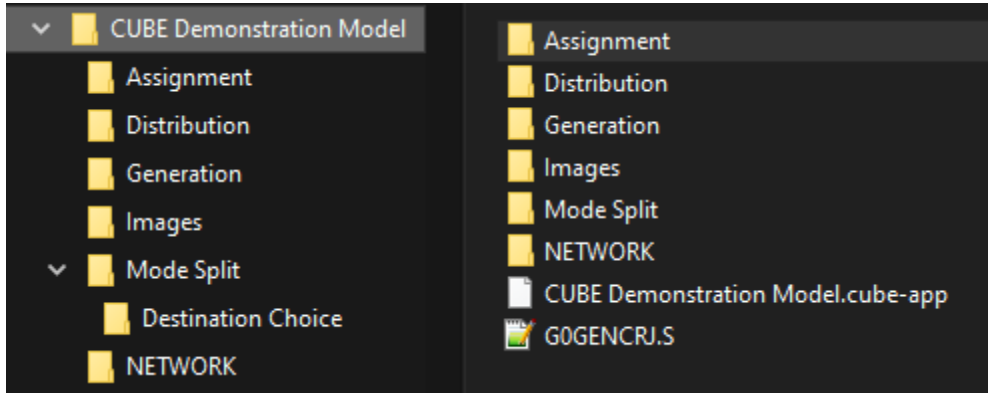
Applications/Groups

- Groups are entities inside applications and not a standalone application
- Individual folders for each application
- Individual folders to save group files (script/print) under each application folder





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