Argonne NATIONAL LABORATORY

TRANSIMS Version 5 Software Architecture

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Topics

- Goals and objectives
- Standard template library extensions
- Code organization and consolidation
- Program service hierarchy
- Typical program linkages
- Path building and simulation services
- Multiple threads, DLL, and MPI

Goals and Objectives

- Make the code easier for new programmers to understand, modify and build upon
  - Standard Template Library
  - Centralize codes, standardize and automate processing
  - Expand and simplify programmer support services
- Make the code safer and more robust
  - Eliminate re-defined data classes and application differences
- Improve performance and reduce run times
  - Utilize multiple cores and MPI clusters
- Create DLL services for linkages to other software

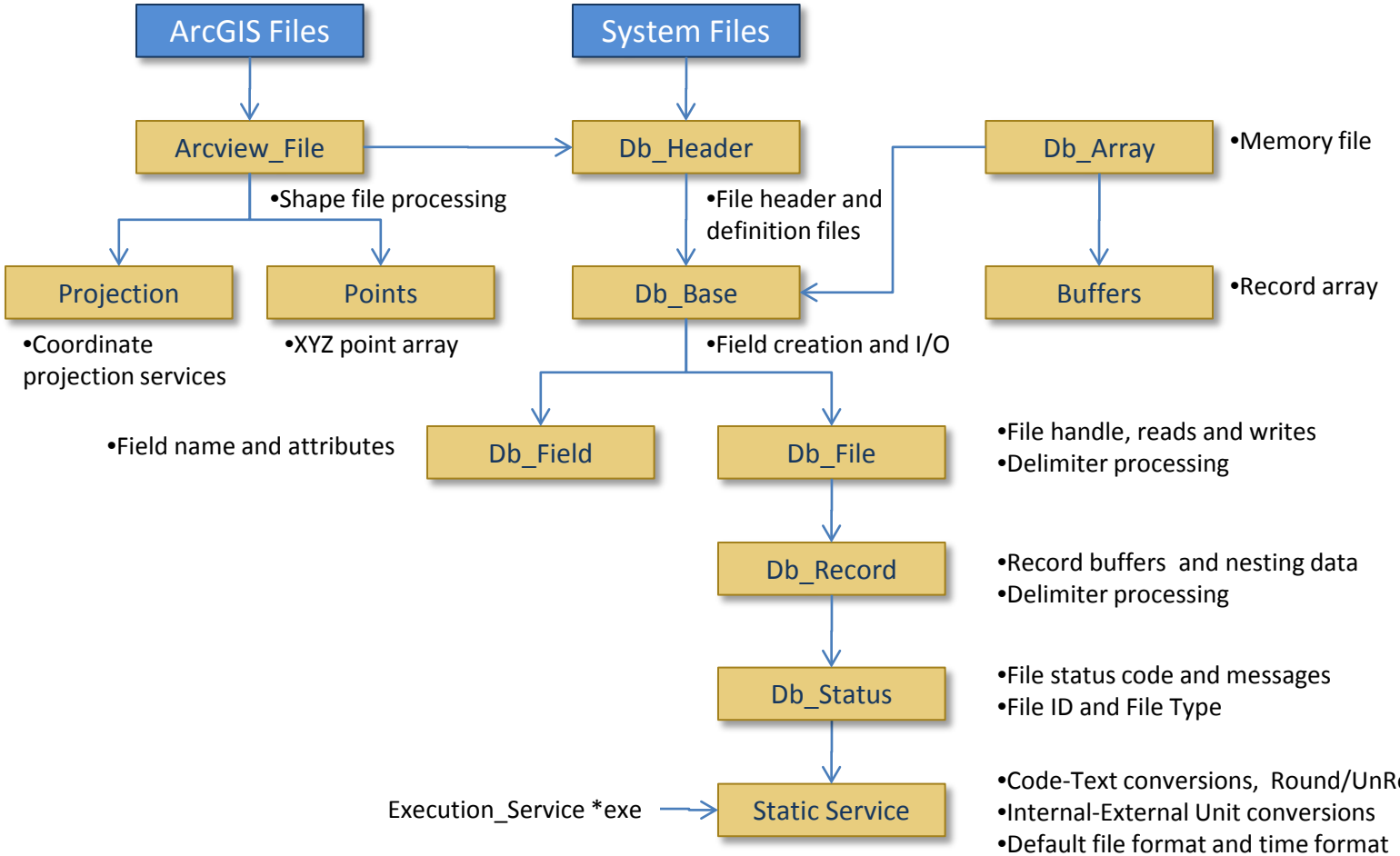
Standard Template Library Extensions

- Custom data containers → C++ STL
  - vectors, maps, iterators, streams, and strings
- Encapsulate and extend STL methods
  - string → String
    - Case insensitive comparisons, trimming, parsing, type conversions, and type safe printf-like formating
  - streams → Message, Print, Write, XML
    - Managed output to the screen and print files
  - char array → Buffer
    - Dynamic character arrays for binary and text file input and output
  - time → Dtime
    - Day-time data object with input and output formatting

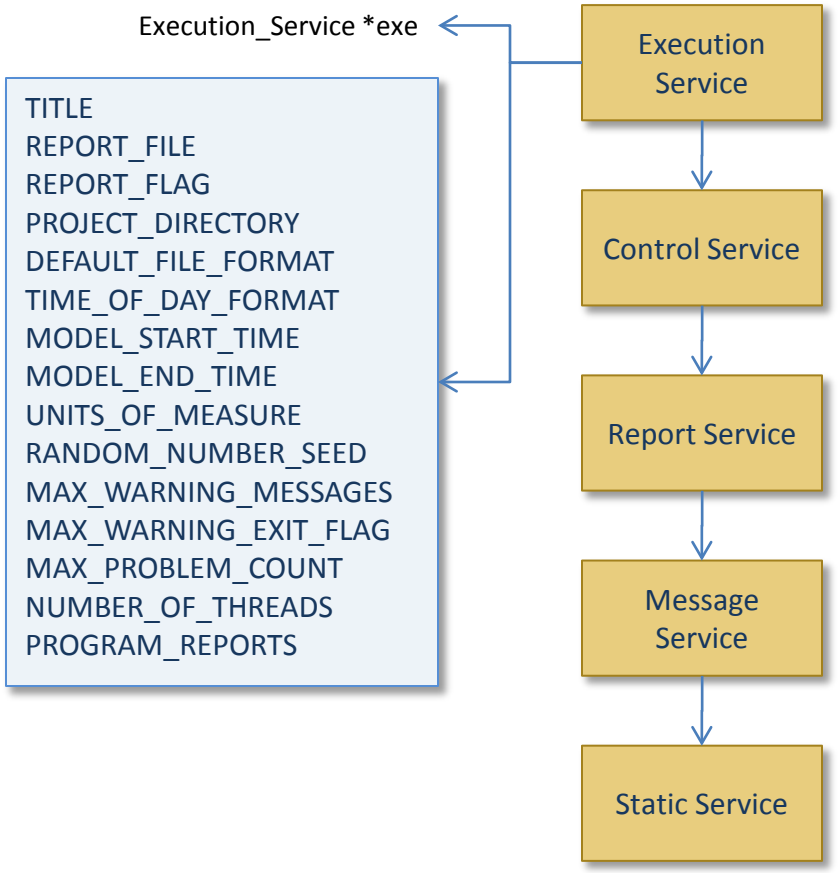
Code Organization and Consolidation

- Enumerations consolidated into one place with static conversion services (text→code, code→text)
- Standard containers and iterators defined in a central TypeDefs library
- SysLib re-grouped and organized as files, data classes, read and write methods, and a series of program services
- Control key structure and processing methods standardize, simplify, and automate user interface and help functions

SysLib Db-File Hierarchy



Low Level Program Services



- Control key and report specifications
- Command line processing
- Program execution process

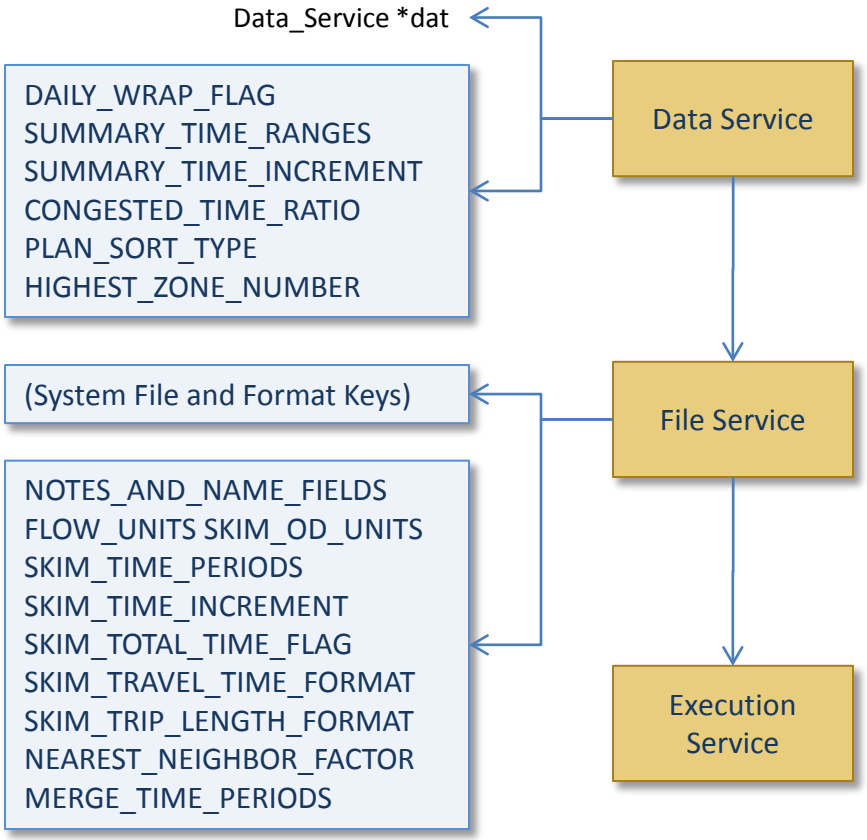
- Control file processing
- Key processing and validation services
- Help services

- Report/XML output
- Problem services
- Partitioning flags

- Screen messages
- Program/Version
- Exit codes

- Code-Text conversions, Round/UnRound
- Internal-External Unit conversions
- Default file format and time format

File and Data Services

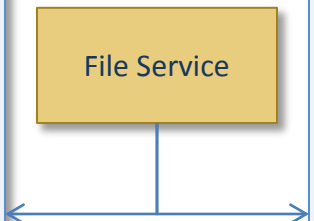


- Read system files into data structures
- Write data structures to system files
- Record indexing and sorting

- System file selection
- Open existing and create new files
- File status and format information

System File and Format Keys

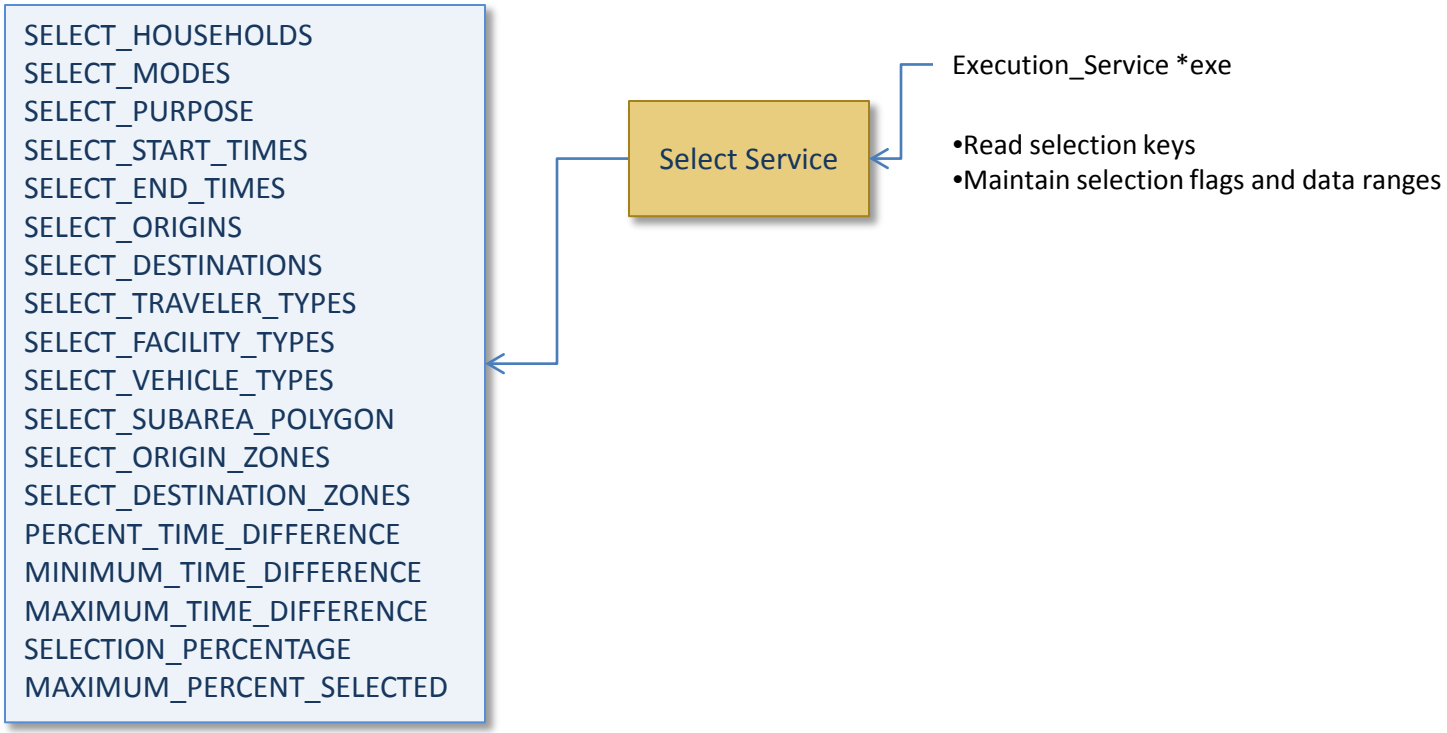
NODE_FILE	NODE_FORMAT
ZONE_FILE	ZONE_FORMAT
SHAPE_FILE	SHAPE_FORMAT
LINK_FILE	LINK_FORMAT
POCKET_FILE	POCKET_FORMAT
LANE_USE_FILE	LANE_USE_FORMAT
CONNECTION_FILE	CONNECTION_FORMAT
TURN_PENALTY_FILE	TURN_PENALTY_FORMAT
PARKING_FILE	PARKING_FORMAT
LOCATION_FILE	LOCATION_FORMAT
ACCESS_FILE	ACCESS_FORMAT
SIGN_FILE	SIGN_FORMAT
SIGNAL_FILE	SIGNAL_FORMAT
PHASING_PLAN_FILE	PHASING_PLAN_FORMAT
TIMING_PLAN_FILE	TIMING_PLAN_FORMAT
DETECTOR_FILE	DETECTOR_FORMAT
TRANSIT_STOP_FILE	TRANSIT_STOP_FORMAT
TRANSIT_FARE_FILE	TRANSIT_FARE_FORMAT
TRANSIT_ROUTE_FILE	TRANSIT_ROUTE_FORMAT
TRANSIT_SCHEDULE_FILE	TRANSIT_SCHEDULE_FORMAT
TRANSIT_DRIVER_FILE	TRANSIT_DRIVER_FORMAT
SELECTION_FILE	SELECTION_FORMAT
HOUSEHOLD_FILE	HOUSEHOLD_FORMAT
LINK_DELAY_FILE	LINK_DELAY_FORMAT
PERFORMANCE_FILE	PERFORMANCE_FORMAT
RIDERSHIP_FILE	RIDERSHIP_FORMAT
VEHICLE_TYPE_FILE	VEHICLE_TYPE_FORMAT
VEHICLE_FILE	VEHICLE_FORMAT
TRIP_FILE	TRIP_FORMAT
PROBLEM_FILE	PROBLEM_FORMAT
PLAN_FILE	PLAN_FORMAT
SKIM_FILE	SKIM_FORMAT



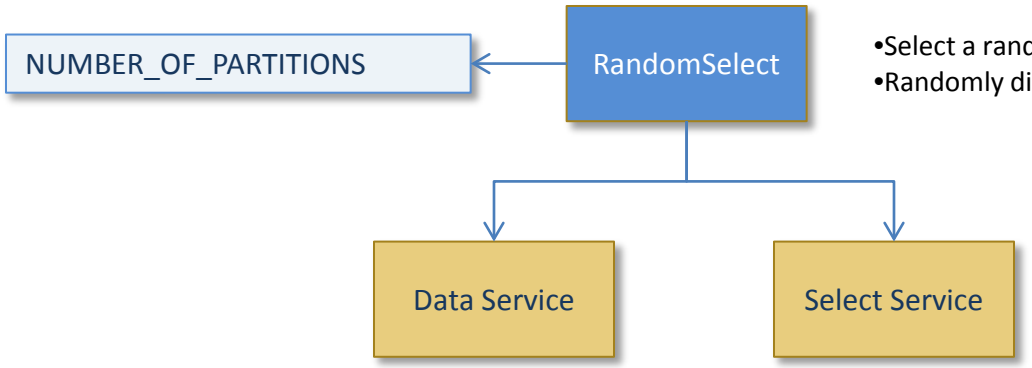
NEW_NODE_FILE	NEW_NODE_FORMAT
NEW_ZONE_FILE	NEW_ZONE_FORMAT
NEW_SHAPE_FILE	NEW_SHAPE_FORMAT
NEW_LINK_FILE	NEW_LINK_FORMAT
NEW_POCKET_FILE	NEW_POCKET_FORMAT
NEW_LANE_USE_FILE	NEW_LANE_USE_FORMAT
NEW_CONNECTION_FILE	NEW_CONNECTION_FORMAT
NEW_TURN_PENALTY_FILE	NEW_TURN_PENALTY_FORMAT
NEW_PARKING_FILE	NEW_PARKING_FORMAT
NEW_LOCATION_FILE	NEW_LOCATION_FORMAT
NEW_ACCESS_FILE	NEW_ACCESS_FORMAT
NEW_SIGN_FILE	NEW_SIGN_FORMAT
NEW_SIGNAL_FILE	NEW_SIGNAL_FORMAT
NEW_PHASING_PLAN_FILE	NEW_PHASING_PLAN_FORMAT
NEW_TIMING_PLAN_FILE	NEW_TIMING_PLAN_FORMAT
NEW_DETECTOR_FILE	NEWDETECTOR_FORMAT
NEW_TRANSIT_STOP_FILE	NEW_TRANSIT_STOP_FORMAT
NEW_TRANSIT_FARE_FILE	NEW_TRANSIT_FARE_FORMAT
NEW_TRANSIT_ROUTE_FILE	NEW_TRANSIT_ROUTE_FORMAT
NEW_TRANSIT_SCHEDULE_FILE	NEW_TRANSIT_SCHEDULE_FORMAT
NEW_TRANSIT_DRIVER_FILE	NEW_TRANSIT_DRIVER_FORMAT
NEW_SELECTION_FILE	NEW_SELECTION_FORMAT
NEW_HOUSEHOLD_FILE	NEW_HOUSEHOLD_FORMAT
NEW_LINK_DELAY_FILE	NEW_LINK_DELAY_FORMAT
NEW_PERFORMANCE_FILE	NEW_PERFORMANCE_FORMAT
NEW_RIDERSHIP_FILE	NEW_RIDERSHIP_FORMAT
NEW_VEHICLE_TYPE_FILE	NEW_VEHICLE_TYPE_FORMAT
NEW_VEHICLE_FILE	NEW_VEHICLE_FORMAT
NEW_TRIP_FILE	NEW_TRIP_FORMAT
NEW_PROBLEM_FILE	NEW_PROBLEM_FORMAT
NEW_PLAN_FILE	NEW_PLAN_FORMAT
NEW_SKIM_FILE	NEW_SKIM_FORMAT

Select Service

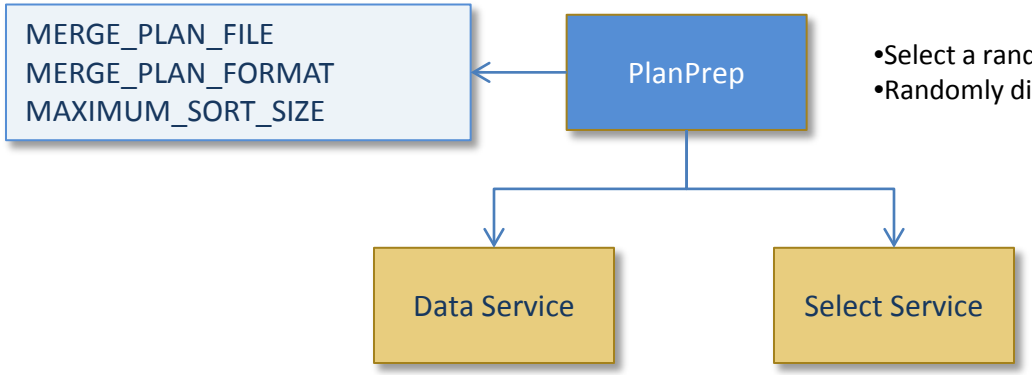
- Support service class for selecting data records



Typical Program Linkages



- Select a random set of travelers or trips
- Randomly distribute travelers to partitions



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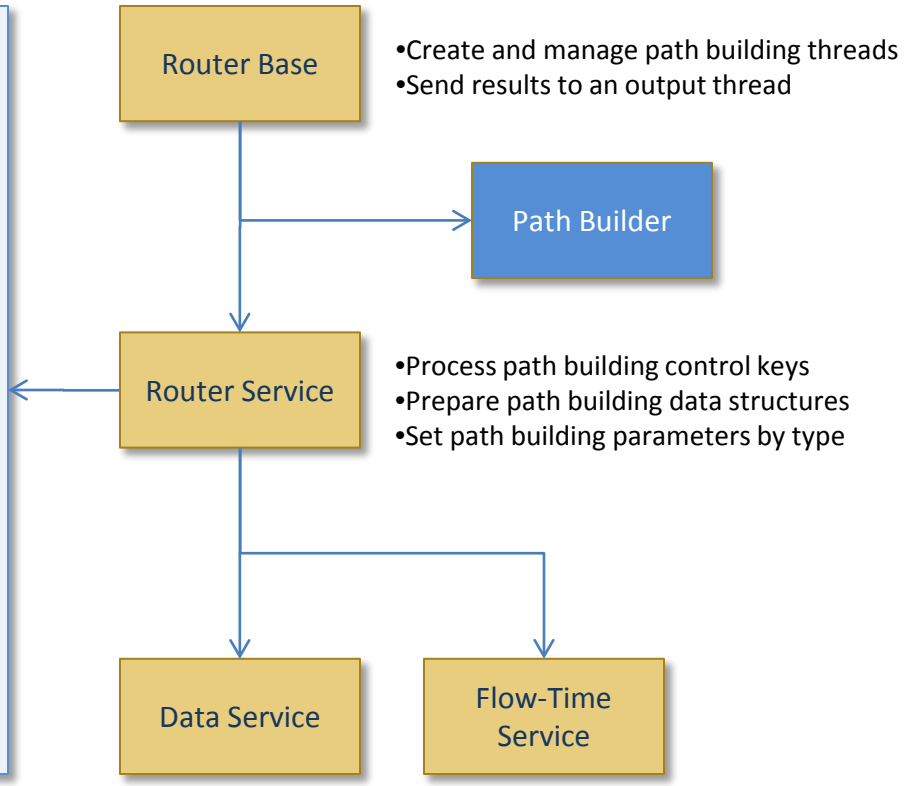
- Randomly distribute travelers to partitions

Path Building and Simulation Services

- Builds private data structures for algorithm needs
  - No longer re-defines or over-writes data in SysLib services
    - SysLib creates internal record IDs for all datasets and programs
    - Re-defining data structures not permitted by STL containers
  - Important for DLL and on-the-fly path building
- Path Builder and Simulator modules in SysLib
  - Available to multiple programs and as DLL services to other software
- Path Builder includes two basic options
  - Construct a path for a specific trip of a specific traveler
  - Construct paths or path skims between a user-defined set of origins, destinations, times of day, modes, and vehicle types

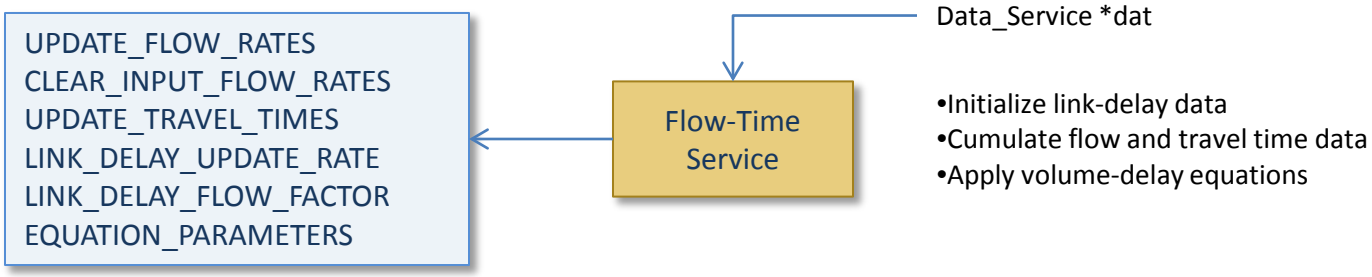
Router Services

IMPEDANCE_SORT_METHOD	STOP_WAITING_PENALTIES
SAVE_ONLY_SKIMS	STATION_WAITING_PENALTIES
WALK_PATH_DETAILS	BUS_BIAS_FACTORS
IGNORE_VEHICLE_ID	BUS_BIAS_CONSTANTS
LIMIT_PARKING_ACCESS	RAIL_BIAS_FACTORS
IGNORE_TIME_CONSTRAINTS	RAIL_BIAS_CONSTANTS
END_TIME_CONSTRAINT	MAX_WALK_DISTANCES
IGNORE_ROUTING_PROBLEMS	MAX_BICYCLE_DISTANCES
PERCENT_RANDOM_IMPEDANCE	MAX_WAIT_TIMES
WALK_SPEED	MIN_WAIT_TIMES
BICYCLE_SPEED	MAX_NUMBER_OF_TRANSFERS
WALK_TIME_VALUES	MAX_NUMBER_OF_PATHS
BICYCLE_TIME_VALUES	MAX_PARK_RIDE_PERCENTAGE
FIRST_WAIT_VALUES	MAX_KISS_RIDE_PERCENTAGE
TRANSFER_WAIT_VALUES	KISS_RIDE_TIME_FACTOR
PARKING_TIME_VALUES	KISS_RIDE_STOP_TYPES
VEHICLE_TIME_VALUES	MAX_KISS_RIDE_DROPOFF_WALK
DISTANCE_VALUES	MAX_LEGS_PER_PATH
COST_VALUES	FARE_CLASS_DISTRIBUTION
FACILITY_BIAS_FACTORS	DEFAULT_PARKING_DURATION
LEFT_TURN_PENALTIES	LOCAL_ACCESS_DISTANCE
RIGHT_TURN_PENALTIES	LOCAL_FACILITY_TYPE
U_TURN_PENALTIES	LOCAL_IMPEDANCE_FACTOR
PARKING_PENALTY_FILE	MAX_CIRCUITY_RATIO
TRANSIT_PENALTY_FILE	MIN_CIRCUITY_DISTANCE
TRANSFER_PENALTIES	MAX_CIRCUITY_DISTANCE

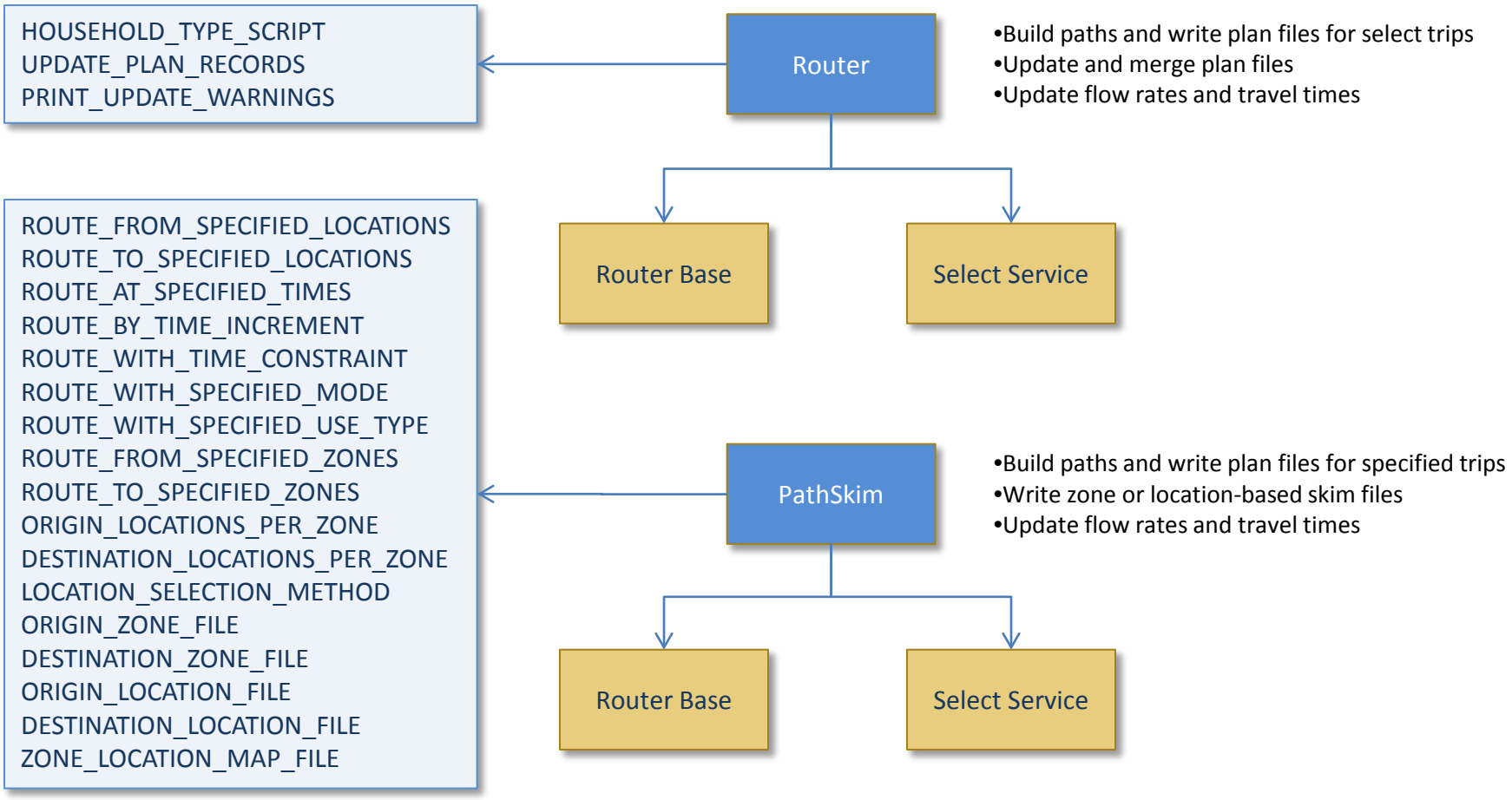


Flow-Time Service

- Support service class for managing link-delay and performance file processing

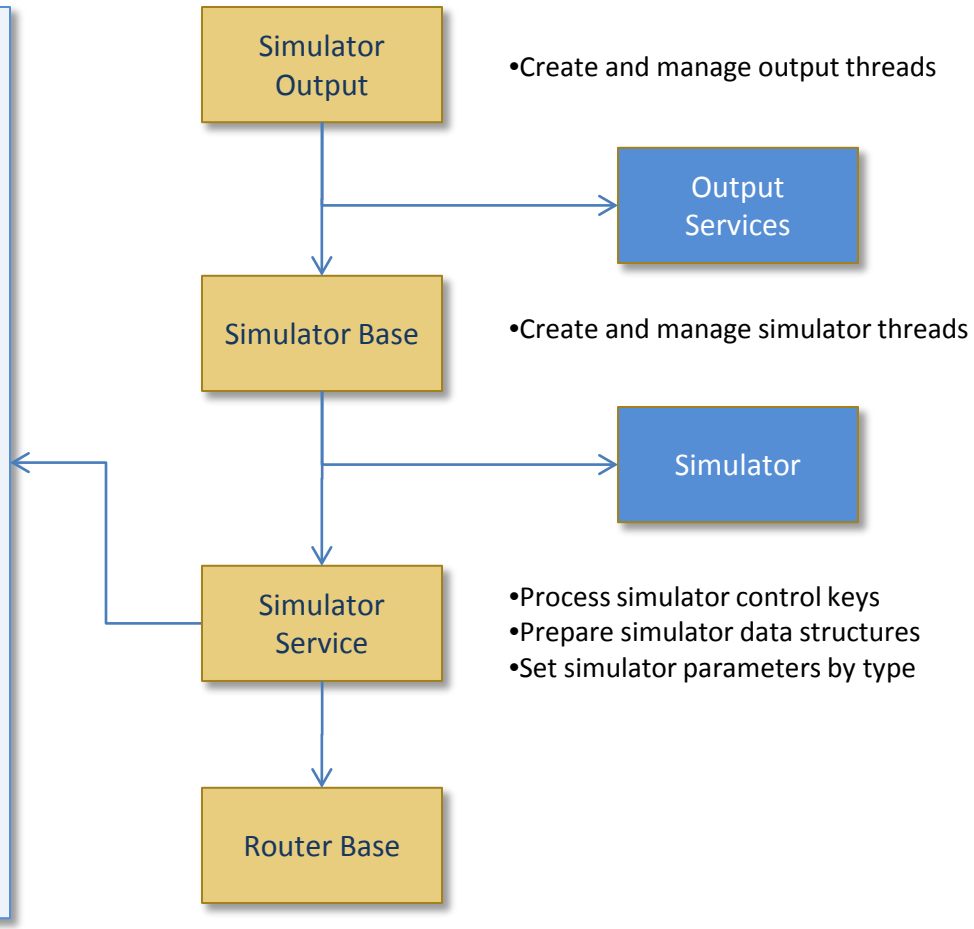


Router and PathSkim Linkages

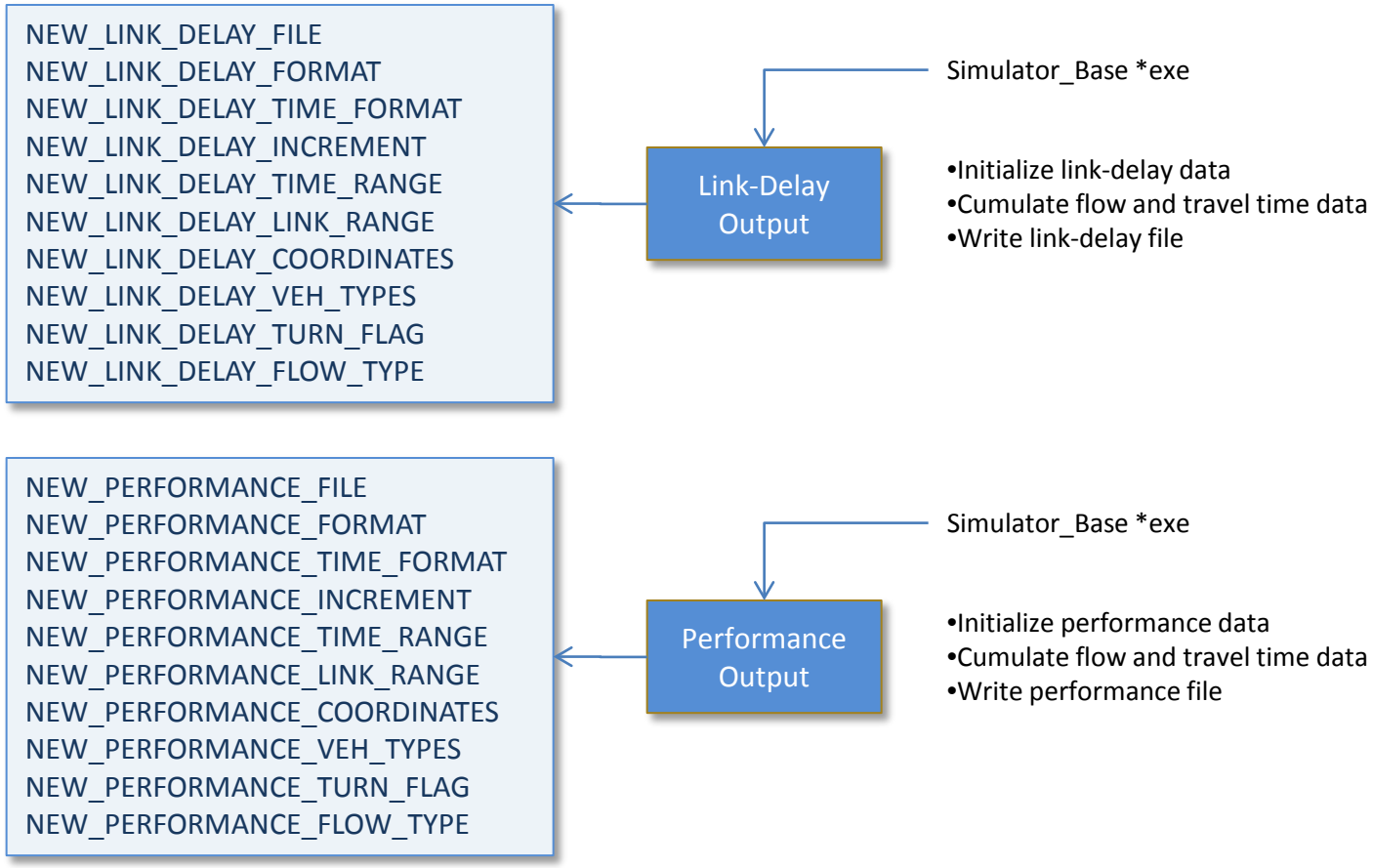


Simulator Services

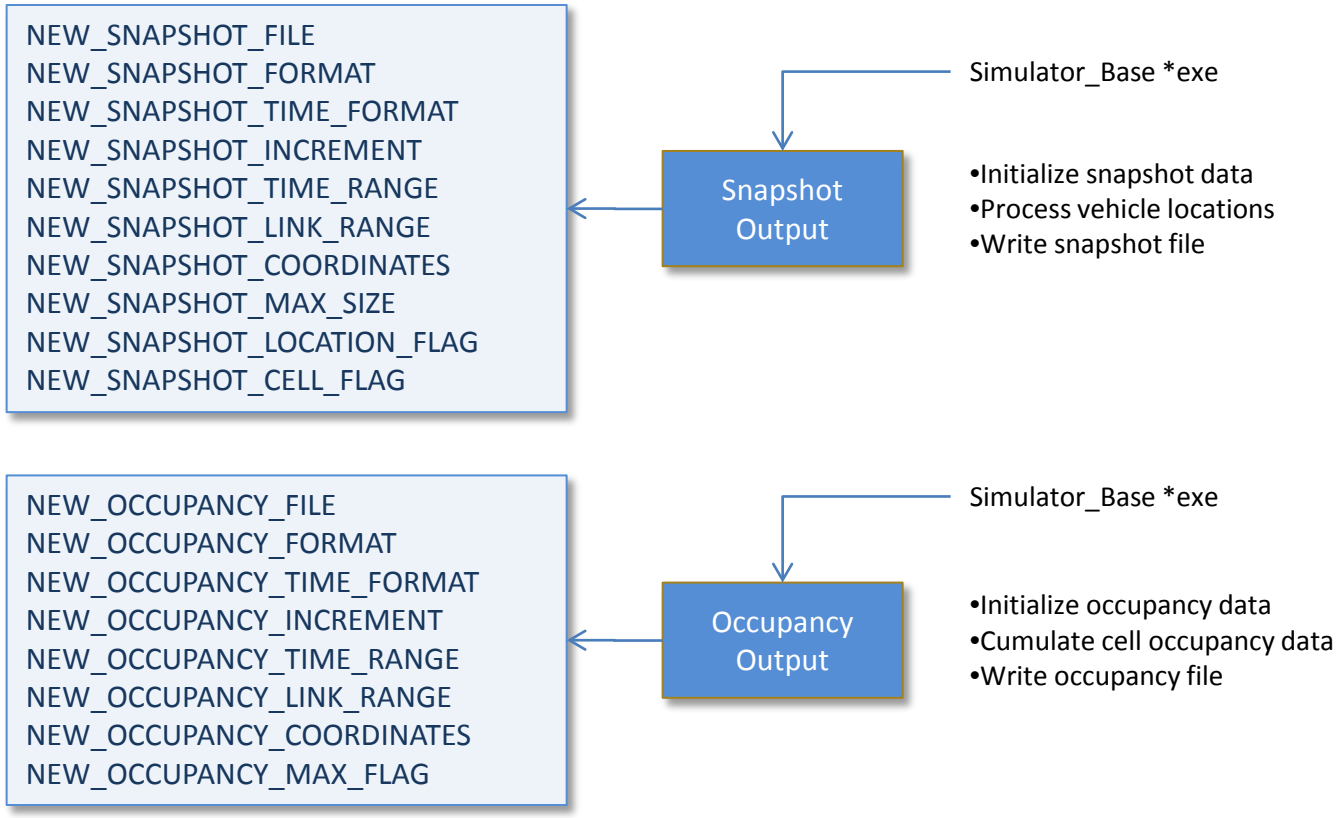
SIMULATION_START_TIME
SIMULATION_END_TIME
TIME_STEPS_PER_SECOND
SPEED_CALCULATION_METHOD
CELL_SIZE
PLAN_FOLLOWING_DISTANCE
LOOK_AHEAD_DISTANCE
LOOK_AHEAD_LANE_FACTOR
LOOK_AHEAD_TIME_FACTOR
MAXIMUM_SWAPPING_SPEED
MAXIMUM_SPEED_DIFFERENCE
ENFORCE_PARKING_LANES
FIX_VEHICLE_LOCATIONS
DRIVER_REACTION_TIME
PERMISSION_PROBABILITY
SLOW_DOWN_PROBABILITY
SLOW_DOWN_PERCENTAGE
MINIMUM_WAITING_TIME
MAXIMUM_WAITING_TIME
MAX_ARRIVAL_TIME_VARIANCE
MAX_DEPARTURE_TIME_VARIANCE
COUNT_PROBLEM_WARNINGS
PRINT_PROBLEM_MESSAGES



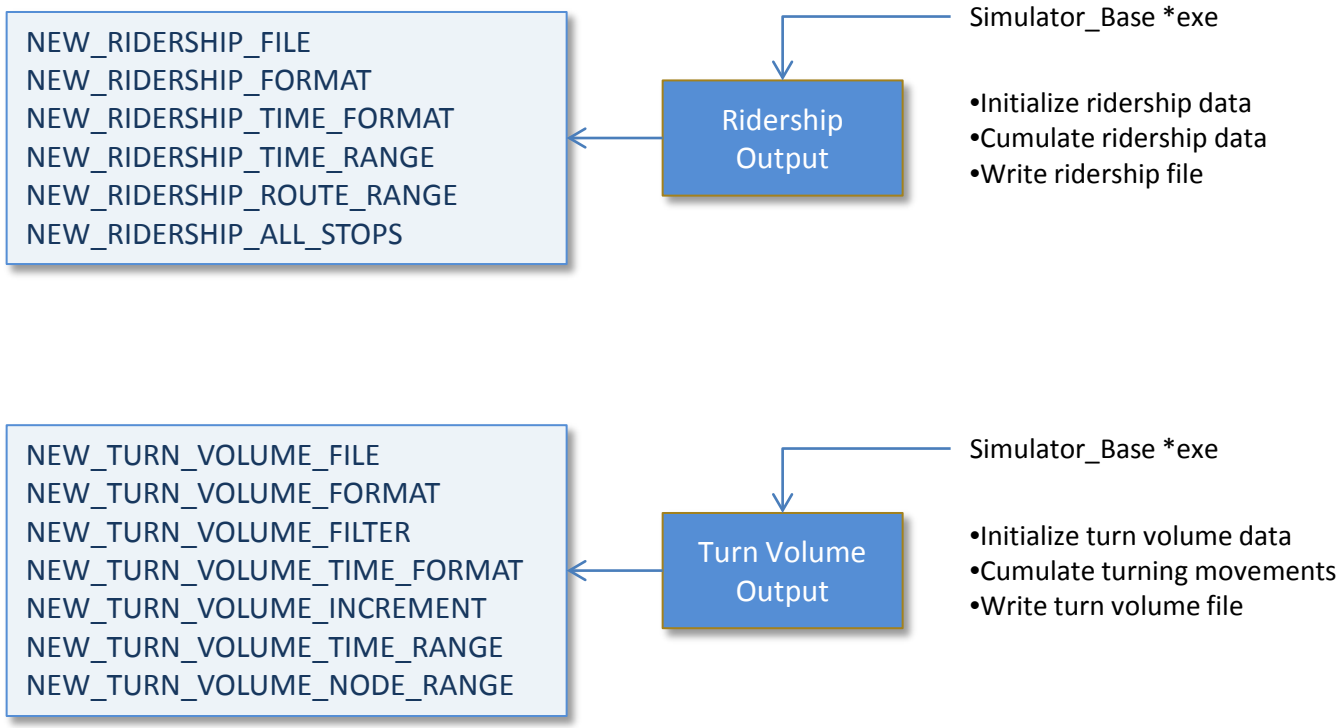
Simulator Output
Link Delay and Performance



Simulator Output
Snapshot and Occupancy



Simulator Output
Ridership and Turn Volume



Multiple Threads, DLL and MPI

- Boost library used for multi-threads
- All SysLib classes available for dynamic linking to other software packages (e.g., Path Builder)
- MPI Microsimulator under development
  - Expand to other thread-ready applications (e.g., Router, PlanPrep)
- Software compiled for multiple platforms
  - Stand-alone single thread – 32 bit and 64 bit (Bin and Bin64)
  - Stand-alone multi-thread – 32 bit and 64 bin (BinBoost, Bin64Boost)
  - DLL single thread – 32 bit and 64 bit (BinDLL and Bin64DLL)
  - DLL multi-thread – 32 bit and 64 bit (BinBoostDLL and Bin64BoostDLL)
  - MPI multi-thread – 32 bit and 64 bit (BinMPI and Bin64MPI)