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Aimsun Next
Editions
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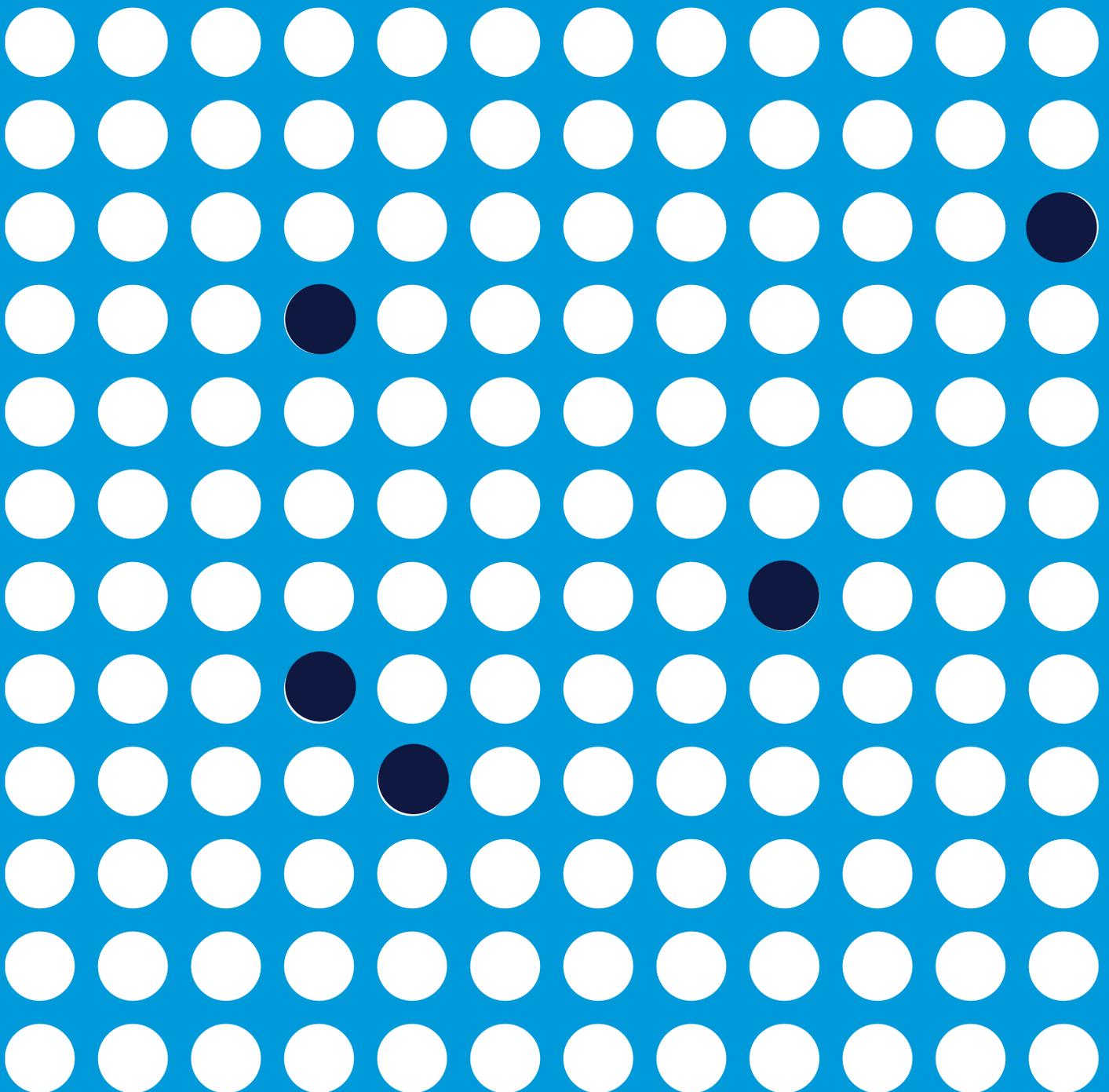
Aimsun editions and extras

Contents

1   Editions

Pro
Aimsun Next Pro edition comes in three flavors, each catering for a single tier of modeling (micro, meso or travel demand modeling):
- Pro Micro
- Pro Meso
- Pro TDM

Select the flavor that fits your specific requirements and enjoy access to the full Aimsun Next platform with no network size limitations.

Advanced
With the Advanced edition you can access static and dynamic traffic assignment, mesoscopic, microscopic and hybrid macroscopic-mesoscopic and mesoscopic-microscopic simulation along with OD matrix manipulation tools for super-sized applications of any kind.

Expert
Our Expert edition has all the benefits of Advanced, but with the addition of travel demand modeling. Now you can use a single software package for an entire transportation modeling project of any scale, from entering raw geographical and socio-economic data all the way through to simulation.

1.1 Features by Edition

Feature	Pro[1]	Advanced	Expert
Microscopic simulation	🟡	🔵	🔵
Pedestrian simulation	🟡	🔵	🔵
Dynamic Public Transport Assignment	🟡	🔵	🔵
Mesoscopic simulation	⚫	🔵	🔵
Hybrid simulation		🔵	🔵
Static assignment-private vehicles	🔘	🔵	🔵
Static assignment-public transport	🔘	🔵	🔵
Travel demand modeling	🔘		🔵
DTA: Stochastic route choice	🟡 ⚫	🔵	🔵
DTA: Dynamic user equilibrium	⚫	🔵	🔵
Parallel[2]	🔵	🔵	🔵
Public transportation simulation	🔵	🔵	🔵
Traffic management	🔵	🔵	🔵

Key
- 🔵 Included
- ⚪ Optional
- 🟡 Included in Pro Micro
- ⚪ Optional for Pro Micro
- ⚫ Included in Pro Meso
- ⚪ Optional for Pro Meso
- 🔘 Included in Pro TDM

Notes

[1] Pro comes in 3 flavors: Pro Micro, Pro Meso, and Pro TDM. All 3 Pro editions provide access to the full platform and to a single model, either microscopic or mesoscopic simulation or travel demand modeling.

Feature			
GIS and CAD interfaces	●	●	●
Scripting	●	●	●
Aimsun Console	●	●	●
Third-party importers[3]	●	●	●
Planning software interfaces (Emme and SATURN)	○	○	○
Adaptive control interfaces[4]	◐ ○	○	○
Control plan optimization[5]	◐	○	○
Additional thread support	○	○	○
Aimsun API	◐ ○	○	○
Aimsun microSDK	◐	○	○
External Agent Interface	◐	○	○
V2X SDK	◐	○	○
Driving Simulators	◐	○	○

[2] Support for 4 threads in Pro and Advanced; support for 8 threads in Expert.

[3] Network backgrounds: CAD, GIS, OpenStreetMap, WMS Server. Other transport software: CONTRAM, Cube, Paramics, Road XML, SYNCHRO, TransCAD, Vissim, Visum. Data sources: GTFS.

[4] With the microsimulator: Lisa+, SCATS, SCATS ITS, SCATS-RMS, Siemens UTC System (with SCOOT), Sitraffic Office, UTOPIA, VS-Plus. With mesoscopic simulation: SCATS and UTOPIA.

[5] The Aimsun Next-SIDRA interface is available from Aimsun and is compatible with all licenses that contain the Aimsun Next microsimulator. The TRANSYT-Aimsun Next link (previously available from TRL, now discontinued) is available only up to Aimsun Next 8.2.3.

1.2 Pro

Our **Pro** edition gives you access to the full Aimsun Next platform with no network size limitations.
Pro comes in three different flavors so you can select your modeling approach:
- Pro Micro, if you just need microscopic simulation
- Pro Meso, if you just need mesoscopic simulation
- Pro TDM, if you just need four-step travel demand modeling with macroscopic functionalities

Pro Micro unlocks access to microscopic network loading with Stochastic Route Choice (SRC) Dynamic Traffic Assignment (DTA).
Microscopic simulation discretizes time and updates the state of each vehicle (speed and position) every simulation step (e.g., every 0.7-0.8 seconds) depending on the state of the surrounding vehicles and on its trajectory:
- if a vehicle approaches a conflict area, applying a gap-acceptance model
- if a vehicle has to change lane, applying a lane-changing model
- if a vehicle has to continue on its lane, applying a car-following model

A specific car-following model captures the behavior of vehicles that don't follow

lane discipline, for example bicycles and motorbikes in most countries, and other motorized vehicles in some regions.

After each calculation cycle of the running simulation (that is, "one-shot" simulation as opposed to iterative simulations for the DUE approach), Stochastic Route Choice (SRC) updates the least cost path trees of each destination (paths from all network links to one centroid) using customizable cost functions that rely mainly on the experienced travel time during the last n cycles of the proper simulation.
Once these trees are updated, the algorithm distributes the vehicles between the available alternative paths with a discrete choice function (Binomial, Proportional, Logit or C-Logit). It therefore represents vehicles that have access to pre- trip or on-trip information.
Pro Micro also includes a pedestrian simulator that models the movement of pedestrians on sidewalks, the interaction between pedestrians and traffic at crosswalks, and the boarding and alighting process at public transport stops.

Pro Meso combines mesoscopic network loading with both Dynamic User Equilibrium (DUE) and Stochastic Route Choice (SRC) Dynamic Traffic Assignment (DTA).

Mesoscopic simulation in Aimsun Next is vehicle-based and lane-based, as micro. The difference compared to micro is that while micro discretizes time and calculates the position of vehicles at each time step, meso discretizes space and calculates the time at which each vehicle enters or exits a lane of road section, which depends on:
- free-flow travel time and queue propagation, which are calculated with a simplified car-following model (simplified because it doesn't consider acceleration and deceleration)
- delay because of a sign or signal at the end of the section, which is calculated running the signal plans (signalized intersection) or with a simplified gap-acceptance model (yield or stop-controlled intersection)
- delay for changing lane, which is calculated with a simplified lane-changing model (simplified because the lane selection is performed only before entering into a section and the delay is estimated from aggregated factors like flow per lane, number of lanes to change, length of the section, reaction time)

In other words, while micro follows the movement of the vehicle continuously, meso doesn't know explicitly what happens inside a road section but takes it into account its effects indirectly. In a very simplified way, you can think of a vehicle in meso as an entity that jumps from a lane of a road section to a lane of the next road section paying a travel time at each move.

Dynamic User Equilibrium (DUE) is an iterative procedure aiming, for each OD pair and each time slice, that actual travel times experienced by travelers departing during the same period are equal and minimal. It therefore represents habitual routes based on historical knowledge of the conditions of the network followed by vehicles without

real time information.

Stochastic Route Choice (SRC) updates, after each calculation cycle of the running simulation ("one-shot" simulation as opposed to iterative simulations for the DUE approach), the least cost path trees of each destination (paths from all network links to one centroid) using customizable cost functions that usually rely mainly on the experienced travel time during the last n cycles of the current simulation. Once these trees are updated, the algorithm distributes the vehicles between the available alternative paths with a discrete choice function (Binomial, Proportional, Logit or C-Logit). It therefore represents vehicles that have access to pre- trip or on-trip information.

Pro TDM focuses exclusively on building four-step travel demand models, from entering raw geographical and socio-economic data all the way through to private and public transport assignment, including feedback loops of skim matrices to distribution and modal split.

1.3 Advanced

The **Advanced** edition of Aimsun Next provides a supremely powerful, flexible and comprehensive framework for multi-resolution transportation studies. Advanced unlocks access to macroscopic, mesoscopic, microscopic and hybrid macroscopic-mesoscopic and mesoscopic- microscopic modeling for private and public transport vehicles, along with OD matrix manipulation tools for super-sized applications of any kind.

The hybrid macroscopic-mesoscopic simulator allows you to extend the scope of a mesoscopic model to capture exterior rerouting effects without too many compromises on the runtime or the calibration effort.

The hybrid mesoscopic-microscopic simulator gives you simultaneous microscopic and mesoscopic simulation, allowing you to model large areas without sacrificing a fine level of detail where needed. It combines an event-based mesoscopic model with a more detailed time-sliced microsimulator to give you the best of both worlds, blending superior computational efficiency with precise representation of traffic dynamics – but only where you really need it.

Alternatively, you can apply the different simulation levels to different subareas and run each one independently. Switching from a regional macroscopic model to a microscopic sub-area model is just a matter of drawing a boundary and running the traversal calculation to compute the subarea OD matrices.

In Aimsun Next Advanced, the flow representation (macroscopic, mesoscopic or

microscopic) is completely independent from traffic assignment. You can combine paths calculated with different assignment algorithms in the same simulation, the same way paths from one simulation level can be used by another level. This feature offers great flexibility to the users and is fundamental in reducing time and costs in calibrating large-scale models.

In terms of Dynamic Traffic Assignment (DTA), to be used in conjunction with a mesoscopic, microscopic and/or hybrid traffic flow representation, Aimsun Next provides the two following approaches:

- A Dynamic User Equilibrium assignment algorithm (DUE) based on an adaptation of the Method of Successive Averages, that can be used in combination with microscopic or mesoscopic vehicle movement to produce Dynamic User Equilibrium paths. The DUE assignment algorithm is an iterative procedure aiming, for each O/D pair and each time slice (customizable), that actual travel times experienced by travelers departing during the same period are equal and minimal.
- A Stochastic Route Choice assignment algorithm (SRC) that updates, after each calculation cycle (Set by the user) of the running simulation ("one-shot" simulation as opposed to iterative simulations for the DUE approach), the least cost path trees of each destination (paths from all network links to one centroid) using customizable cost functions that usually rely mainly on the experienced travel time during the last n cycles of the proper simulation. Once these trees are updated, the algorithm distributes the vehicles between the available alternative paths with a discrete choice function (Binomial, Proportional, Logit or C-Logit).

The different assignment algorithms reproduce different levels of travel time information: Static or Dynamic User Equilibrium represents habitual routes based on historical knowledge of the conditions of the network followed by vehicles without real time information; Stochastic Route Choice represents vehicles that have access to pre-trip or on-trip information.

In addition, it is possible to use the routes generated from a macro static assignment as the initial point of a DUE experiment, thus reducing considerably the number of iterations needed to achieve convergence.

The ability to combine different kinds of paths is not only more representative of real behavior, it is necessary for the analysis of non-recurrent conditions, whether scheduled, like road works, or unscheduled, like an accident. In these situations, the network is not in equilibrium, and the majority of the vehicles become aware of an extraordinary event only when they reach it. Drivers then begin to look for an alternative path or receive advance warning and change their route in advance. In summary, Aimsun Next is the best tool for performing different types of transportation analyses without having to learn how to use different software packages

and avoiding duplication of information if you are carrying out multiple studies on the same area.

1.4 Expert

Aimsun Next **Expert** is possibly the most powerful, flexible and comprehensive framework available for analyzing and modeling all types and scales of transportation problems. In addition to multi-resolution transportation studies, with Aimsun Next Expert you can also undertake travel demand modeling.
For example, if the goal is a long-term analysis of the impacts of changes in land use

in a region, you can build a four-step macroscopic model; if the goal is the analysis of traffic dynamics and congestion patterns over a large area, you can build a mesoscopic model; if the goal is testing the impact of construction, you can build a microscopic or a hybrid mesoscopic-microscopic model.

With Aimsun Next Expert you can start a transportation modeling project from scratch, entering raw geographical and socio-economic data and follow the process all the way through to simulation without recourse to a separate package. Being able to use a single software application for an entire project means vastly increased cost-efficiency, consistency and quality.

Additionally, Aimsun Next Expert enables implementing modelling workflows that are impractical, if not impossible, with separate packages: for example, you will be able to get the skims by assigning traffic to the network using a Hybrid network loading with Dynamic User Equilibrium path calculation, and then running a PT assignment that uses the travel time for buses resulting from this dynamic simulation.
This allows you to take into account the effect on distribution and mode split of operational changes made to the public transportation network, such as the introduction of transit signal priority and reserved lanes along a corridor.
Expert also increases the support for multithreading to 8 threads.

2   Aimsun Next optional components

Aimsun includes as standard with every edition a complete set of interfaces with several transportation simulation and signal optimization tools, including:

- GIS importer and exporter
- SYNCHRO importer and exporter
- Visum importer
- Vissim importer

- Paramics importer
- CONTRAM importer
- CUBE importer

In addition, Aimsun Next offers optional components to extend the features offered by the different editions:

- Adaptive Control Interfaces
- Planning Software Interfaces
- Signal Optimization Interface

2.1 Adaptive Control Interfaces

The Adaptive Control Interfaces allow Aimsun Next to communicate during a microscopic simulation with third-party signal controller emulators. Aimsun Next provides the detection actuations produced during the simulation, and the external controller emulator returns the state of the signals to Aimsun Next according to its optimization logic.

It's worth noting that the interface doesn't emulate the adaptive control system itself; it emulates the communication between the real detectors, the signal controllers and the system. The aim is to simulate reliably networks where those systems are in use, or to assess their effect.

The Adaptive Control Interfaces provide a connection with an external adaptive controller emulator, which has to be provided by the company who develops the adaptive control system. This connection is used to send to the controller detection data from the simulation running in Aimsun Next, and to receive from it the state of the signal groups, which affect the behavior of the vehicles in Aimsun Next. The traffic is completely handled by Aimsun Next, i.e. the demand you define in Aimsun Next is the one that generates the detection actuations that are sent to the controller.

Aimsun supports the following systems:

With the microscopic simulator:
LISA+, SCATS, SCATS-RMS, SCOOT, Fast SCOOT UTC, Siemens C800, C900 and sX controllers, UTOPIA, VS-Plus and as customized developments also ETRA, INDRA, SICE, Telvent, and ZGZ Prio.

With the mesoscopic simulator: SCATS and UTOPIA.

The Adaptive Control Interfaces module is available as a paid optional module.

2.2 Planning Software Interfaces

The Planning Software Interfaces allow the user to interchange data between Aimsun and Emme or Saturn.

The interface with Emme provides the following functionalities:

- Translation of an Aimsun network model into an Emme model
- Generation of input files for Aimsun from an Emme assignment
- Generation of an Aimsun network model mock-up from an Emme model
- Matrix import and export
- Matrix adjustment using Emme algorithms
- Traversal generation using Emme algorithms

The interface with SATURN allows the user to import from or to export to SATURN, the network and the OD matrices.

The Planning Software Interfaces module is available as a paid optional module.

2.3 Signal Optimization Interface

The signal optimization interfaces in Aimsun Next provide links to third party signal optimization software. The interface currently available is with SIDRA.

The Interface requires a license for both Aimsun Next and the signal optimization interfaces component. It may also require a license for the signal optimization software.

2.4 Driving simulation

If you have developed the vehicle control logic in SCANeR, or you want to drive a vehicle in the microscopic simulation, we have completely redesigned the interface with this driving simulation software (requires a separate license).

The Driving Simulation Interface is a fully supported and redesigned TCP/IP connection between SCANeR and Aimsun Next. This interface allows a choice

between 'traditional' driving simulator applications, where a human driver sits down at a console and controls a vehicle within a microscopic simulation, or an automotive simulator, which bypasses the human element entirely and creates in SCANeR virtual sensors and an autonomy stack to take control of a vehicle.

3   Aimsun Next programming tools

Users wishing to extend and/or customize the features of Aimsun Next have sets of tools at their disposal, each with a different purpose:
- Scripting
- API
- microSDK
- V2X Software Development Kit
- External Agent Interface

3.1 Scripting

Scripting allows the user to write Python scripts to access and modify the model database.

Scripting is designed to automate some operations that would otherwise be performed manually via the user interface.

Typical tasks are:
- Modifying the network
- Importing and exporting data
- Performing calculations with the simulation outputs
- Adding custom attributes

Scripting is included as standard with every edition of Aimsun Next.

3.2 API

API is a collection of functions, in Python or C++, that allow users to perform certain actions during the mesoscopic, microscopic or hybrid mesoscopic-microscopic simulation.

The functionality that API provides depends on the simulation engine.

In a microscopic simulation (or in the microscopic area of a hybrid mesoscopic-microscopic simulation), you can, at each simulation step, read the data coming from virtual sensors, read the information about vehicles in the model (origin, destination, behavioral parameters, current path, position, speed, acceleration), introduce new vehicles, take control of vehicles (setting their position and speed, and changing their destination or their path), and trigger traffic management actions.

In a mesoscopic simulation, you can read the information about vehicles in the model (origin, destination, current section or turn) at any time and introduce new vehicles.

In both meso and micro, you can read the output statistics, read the state of the signals, and change the state of the signals.

The scope of Aimsun API is the simulation of Intelligent Transportation Systems (ITS), that is: adaptive traffic control; traffic management; vehicle guidance, etc.

Note that when using Scripting, static changes are made before the simulation starts, while with API dynamic changes are made while the microscopic simulation is running.

API is available as a paid optional module.

3.3 microSDK

microSDK) allows users to replace microscopic models (car-following, lane- changing, etc.) with their own behavioral models, programmed in C++.

The microSDK is best suited to when the user has to implement a logic to continuously update the position and speed of individual vehicles depending on the surrounding vehicles. The advantage of microSDK is that users can isolate the subset of behavioral models that they wish to override, and Aimsun Next will automatically apply the default models to the rest.

It is possible to combine API and microSDK (e.g. to control the path in addition to the dynamics of the vehicles).

microSDK is available as a paid optional module for Pro Micro, Advanced or Expert.

3.4 V2X Software Development Kit

The **V2X Software Development Kit (V2X SDK) is designed** for testing connected vehicle applications.

A Vehicle Ad Hoc Network (VANet) is an ephemeral network spontaneously created by a collection of connected vehicles in proximity to each other or in proximity to a similarly connected road-side unit (RSU). The communications are generically referred to as V2V for Vehicle-to-Vehicle communications, V2I for Vehicle-to-Infrastructure

communications, or, when both are operating together, V2X communications.

The V2X SDK, introduced in Aimsun Next 8.4 as a technology preview, is intended to include VANet communications in an Aimsun Next simulation by exchanging messages between vehicles and roadside units where those messages are based on industry standard protocols.

The design principle behind the Aimsun Next V2X SDK is to provide an extensible system in which standardized message protocols are pre-programmed and to which new, experimental protocols may be added. Similarly, recognizing the complexity of the task, the transmission and VANet membership protocols are simulated as simple communications channels, with a range and a stochastic probability of successful transmission, while the on-board units (OBU) in the vehicles are also implemented by default as simple transmitters and receivers.

For more complex studies that focus on the communications as much as the vehicle and management actions, the modeler may replace the channels and OBUS to include more of the communications protocol details. The messages received by the road-side units and the vehicles are intended to be used as inputs to a "Rules Engine", which will then influence the management of the traffic network or the actions of each vehicle according to the data received from other vehicles in the VANet.

The V2X SDK is licensed separately from Aimsun Next editions. The Aimsun Support team will aid you in the acquisition of the V2X plug-in, which includes the user interface required to generate the OBUs, the RSUs and the Traffic Management Centre, as well as to link them by channel/message type. The V2X SDK also includes the API components required to implement a "Rules Engine" in the vehicle or RSU.

3.5   The External Agent Interface

The External Agent Interface (EAI) is designed to introduce an externally controlled vehicle into an Aimsun Next simulation and have that vehicle guided by the actions of, for example, a human driver in a simulator, an autonomous vehicle controller, or by an

experimental control system being tested in a simulation environment.

The data exchanged via the EAI is based on geographic locations expressed as XY, the traffic network expressed as lane co-ordinates rather than being based on a simulated representation of road sections and turns. This means that the external control logic does not require detailed knowledge of how Aimsun Next models the traffic network; it can continue to use its own network model. Data exchange relies solely on there being a shared common co-ordinate system. The external vehicle is positioned in the

traffic network in the simulation and the other vehicles in the simulation, which are controlled by Aimsun Next as normal, will then react to the presence of this external vehicle by following it, collaborating with its lane change maneuvers, and including it in their assessment of gaps at junctions in the same way as they react to other simulation vehicles.

The EAI uses Google Protocol Buffers for data transfer, ensuring cross-platform compatibility and also allowing the controller developer to use any programming tools and languages supported by Google. Aimsun does however also provide a simple interface, single vehicle interface, using a Windows DLL, usable in a Visual Studio project or from Matlab. The data transferred from the simulation to the external agent is the location of the vehicles and pedestrians surrounding the agents and the state of nearby traffic signals. The data transferred to the simulation from the external agent is the new speed, heading and position of the controlled vehicles.

The EAI differs from the Aimsun Next API and the Aimsun Next microSDK in that it does not require the external controller to include any of the simulation artefacts such as road sections, nodes or turns; the external agent is not constrained to work within those structures. All that is required, is a common coordinate system and a common map of the traffic network.

The EAI is licensed separately from Aimsun Next editions. The Aimsun Support team will aid in the acquisition of the EAI plug-in, the simplified external agent DLL with sample code, and the protocol buffer specification file which enables platform independent coding and use with multiple external vehicles.

The EAI is also needed to interface Aimsun Next with Siemens Simcenter Prescan.

4   Aimsun Next Viewer

The Viewer is a quick and simple way to show models to remote third parties, even if they don't have access to Aimsun Next software.

Any Aimsun Next license holder with an up-to-date Software Update Subscription (SUS) can request a free Viewer for an unlimited number of clients or colleagues, so that they can replay a recorded simulation or retrieve data from a previous execution of any Aimsun Next model.

The Viewer's focused functionality means that even non-modelers will find it easy to operate: users can filter and customize what they see, but since there is no need to make changes, there are no editing functions and the focus is entirely on visualization.

The Viewer has the following functions:

- Open an .ang file
- Retrieve results from a database, 4-step model result files, path assignment files and real data sets
- Play a recorded simulation
- Apply view modes in the 2D view and in a detailed node view
- Hide/reveal dynamic labels
- Open and view print layouts
- Open a time series viewer and add time series
- See space/time diagrams for existing detector sets
- Open 2D and 3D views and select bookmarks
- Select an active experiment to see the effect of geometry configurations and overrides
- Filter the view by subnetworks
- Show location in Google Maps