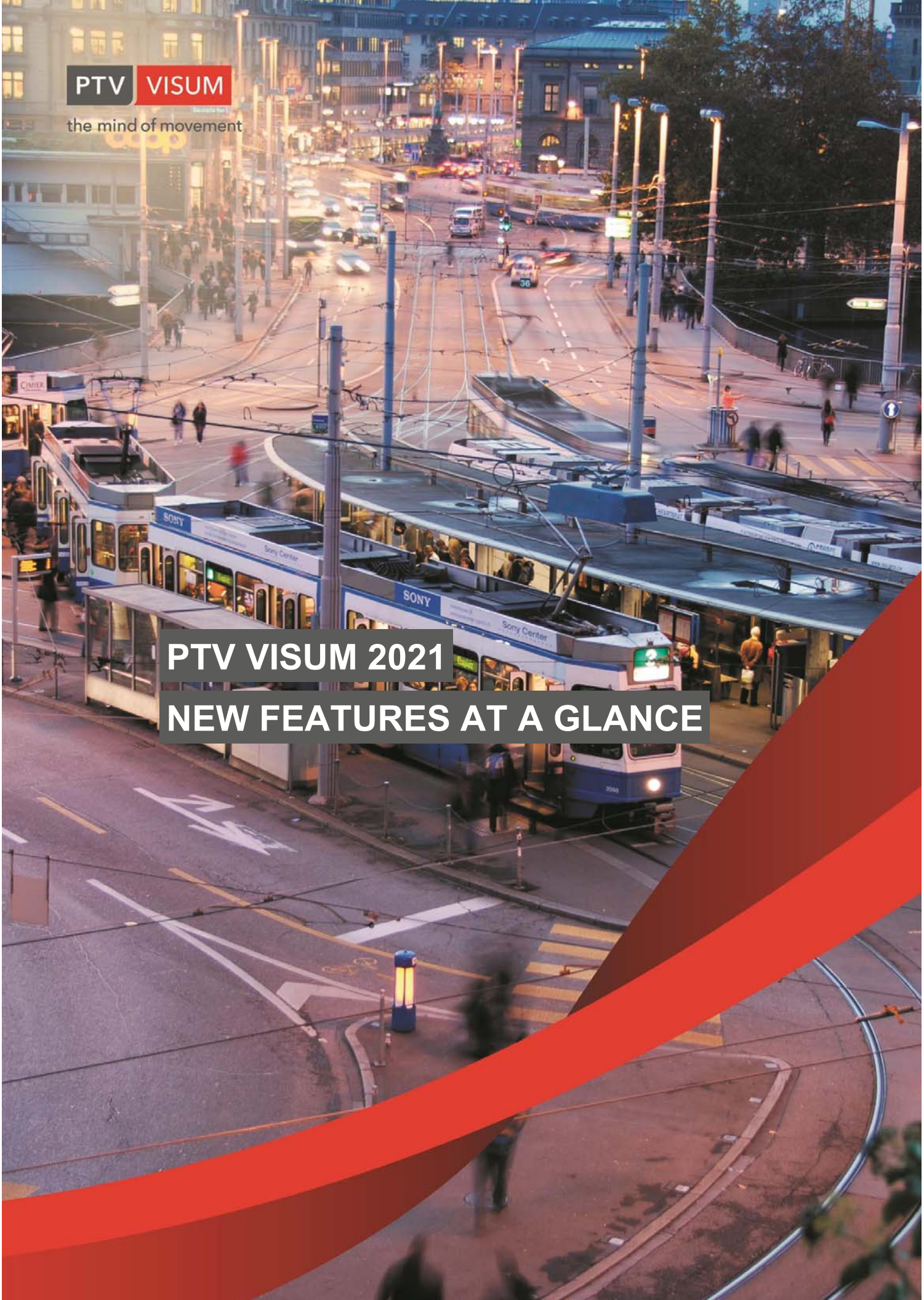

PTV VISUM 2021

NEW FEATURES AT A GLANCE

Impressum:

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Contents

1 Procedures

1.1 Hard capacity constraints in the timetable-based assignment

The use of public transport is increasing year after year. To ease the traffic problems in the cities and especially to reach climate policy goals, even more, passengers have to switch from cars to buses and trains. The passenger records of the last years are pushing the existing public transport services to their capacity limits, especially in cities. Due to established distancing rules, the capacity of vehicles will decrease which amplifies the problem. To identify the effects of crowding and to estimate its consequences, PTV Visum takes into account the capacities of the vehicles used in the timetable.

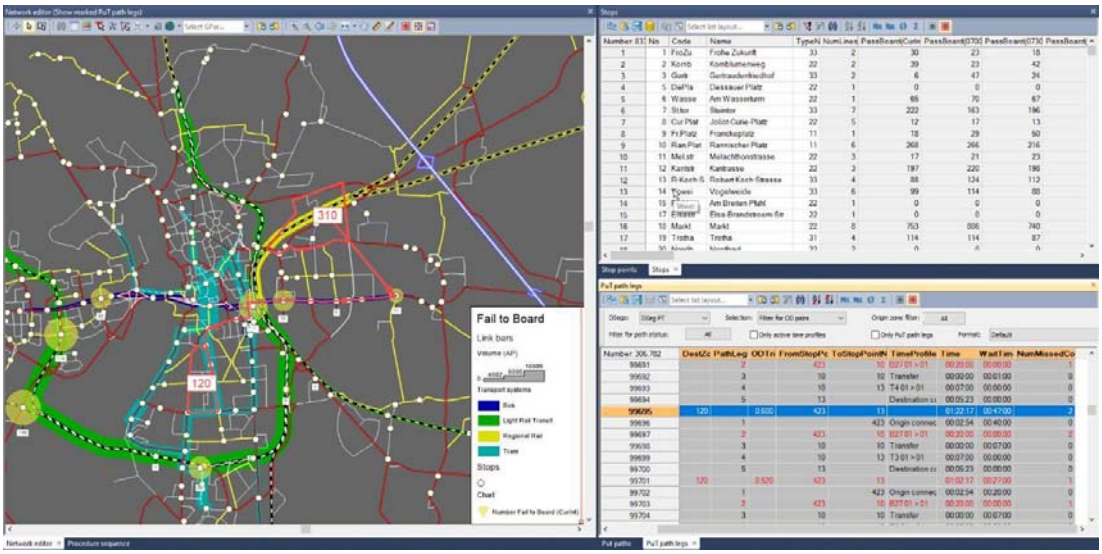
In the existing capacity-constrained, timetabled- based assignment., an overcrowded vehicle is perceived by passengers as uncomfortable and the journey time in such a vehicle is perceived therefore longer. The impedance to choose such a connection increases. Passengers are pushed to take alternative routes. Depending on the quality of the alternatives, however, the original connection may remain overcrowded, especially if only significantly worse alternatives are available.

PTV Visum 2021 extent the timetable-based assignment and introduces hard capacity limits for vehicles and their journeys. As a result, passengers fail to board a vehicle if it has already reached its capacity limit. As a result, vehicles can no longer be overcrowded.

The procedure is based on the existing timetable-based assignment. Passengers who were unable to board the train will look for an alternative connection. The search begins at the time and at the stop where the passenger had to let the full vehicle go. All connections of boarding or changing passengers are affected to the same extent. The alternative routes found are linked to the original broken connections and the number of missed connections is noted. Passengers who do not find alternatives will not be assigned.

This connection set can be used as a basis for evaluating timetable scenarios. Helpful indicators such as the number of passengers who failed to board or the risk, i.e. the probable delay caused by a prevented boarding, are shown separately on the connection, per stop or as a matrix.

Evaluations are possible that dynamically visualize the number of people who could not board due to lack of vehicle capacity. Their resulting routes are available in lists and show the correspondingly increased waiting time.



1.2 Improvements for the intermodal assignment (PT + Ride Sharing)

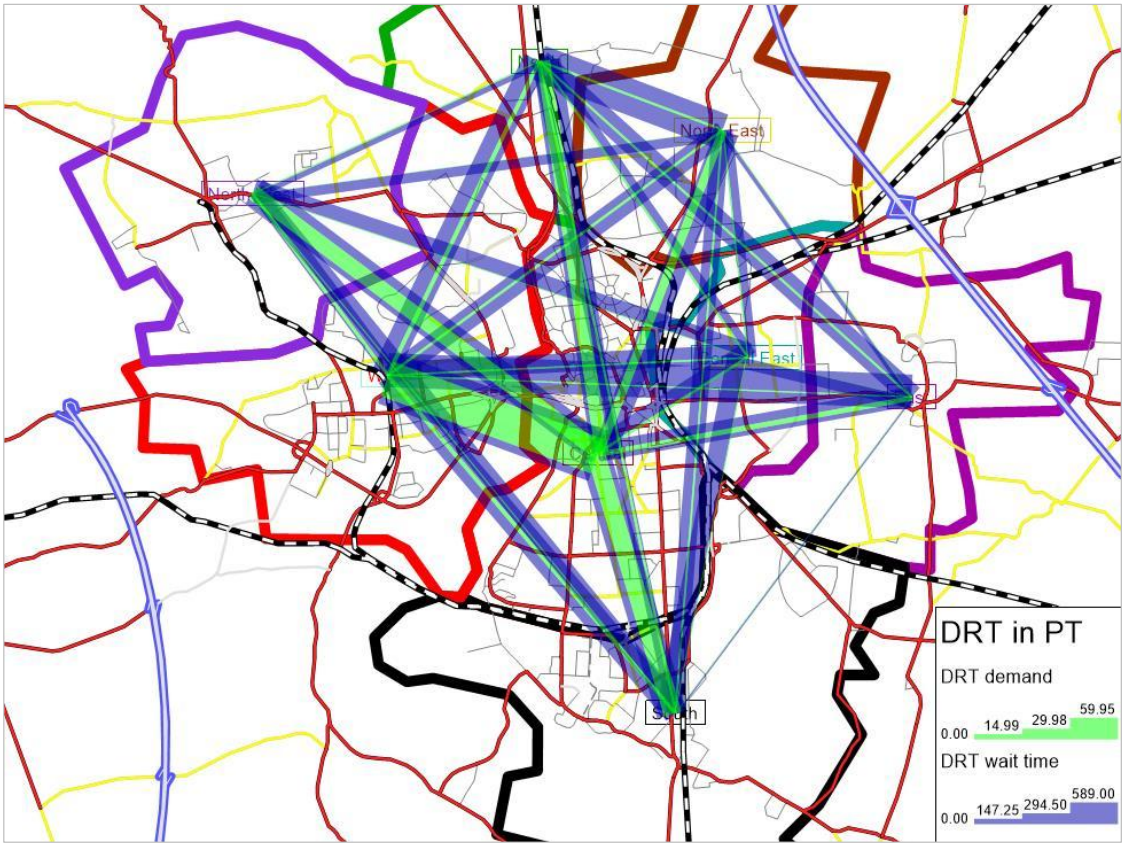
Based on the experience of users with the intermodal assignment, we have made numerous additions and extensions. As a result, the assignment is faster and more stable. In addition, it is now possible to perform a time-saving warm start and use the results of a previous run. In this respect also the analysis of the DRT results has been made more user-friendly.

A stabilizing element visible for the user is the consideration of the uncertainty about the real DRT performance parameters (for example, the detour factor). These parameters, which determine the impedance of the DRT path leg during the connection search, change from iteration to iteration. With the previous Visum release, it could happen that connections were dominated in an early search iteration and therefore deleted from the connection set, which would not have occurred with the final performance parameters.

For this reason, we introduced factors for the minimum and maximum search impedance. A connection dominates another one only if it still dominates after applying the maximum factor. Accordingly, a connection is dominated only if it is still dominated after applying the minimum factor.

Since a ride-sharing system has a limited capacity, the tour planning simulation can produce unserved trip requests. Since such unserved demand has a considerable influence on choice probability, the impedance definition of the DRT path legs has a corresponding component that somehow considers this phenomenon. We have adjusted this component so that the caused passenger loss is approximately identical to the number of unserved passengers.

Another extension is the storage of the final converged DRT performance parameters in main zone matrices. This results in two exciting applications: On the one hand, the parameters can now be visualized and analyzed quickly. On the other hand, they can be used as initial parameters in a subsequent assignment, which can lead to an enormous saving of computation time.



Graphical comparison of DRT demand with DRT waiting time in the form of main zone desire lines

1.3 Extensions of the dispatcher for ride sharing systems

In Ride Sharing systems, the dispatcher allocates the vehicles to the known trip requests. The dispatcher checks the next available trip request, filters the vehicles in question and then selects the most cost-effective one to serve the trip request. However, trip requests with a long pre-booking time offer the potential for better optimisation and thus a more cost-effective solution for the operator. In PTV Visum 2021, it is possible to specify a distribution of pre-booking times. Periodic reoptimization of the allocation of vehicles to trip requests is possible in dispatching, based on tour planning procedures. After an adjustable interval of trip requests, a reoptimization of all trip requests is carried out that are already known to the system and have not yet been processed. This improves the utilization of the Ride-Sharing system.

Ride sharing systems are presented as new mobility concepts and in their planning it is often assumed that the vehicle fleet is powered by batteries. With PTV Visum 2021, the boundary conditions of such battery electric operation can be modelled. Vehicle dispatching takes into account both the limited range and the conditional availability of the vehicles during the charging process. As a user, you can use the specifications of your vehicles and charging infrastructure to investigate the impact on the ride sharing system, operating costs and service quality.

Central holding areas for vehicles in a ride sharing fleet increase availability for the user and prevent vehicles in remote locations from waiting in vain for a new request. These holding areas can be modeled in the network, just like the charging infrastructure. The dispatching

of the vehicles therefore no longer only checks whether a vehicle can serve a new request, but also what the current state of charge is and whether it has already been without an order for a certain time and should move to a more central location.

1.4 Add-In for automatic demand calibration

When creating transport models, demand model calibration is one of the most complex work steps. The newly developed calibration tool can help to reduce this effort significantly.

The calibration tool supports the calibration of the modal split and the calibration of the travel distance. Optionally, a further calibration level can be selected, e.g., modal split per person group. In addition, the set of OD relations where the calibration acts can be restricted. This makes it possible to calibrate the modal split of commuters.

The calibration tool consists of two AddIns: "Demand calibration preparation" which prepares the model for calibration, and "Demand calibration" which is part of the procedure sequence as an independent procedure.

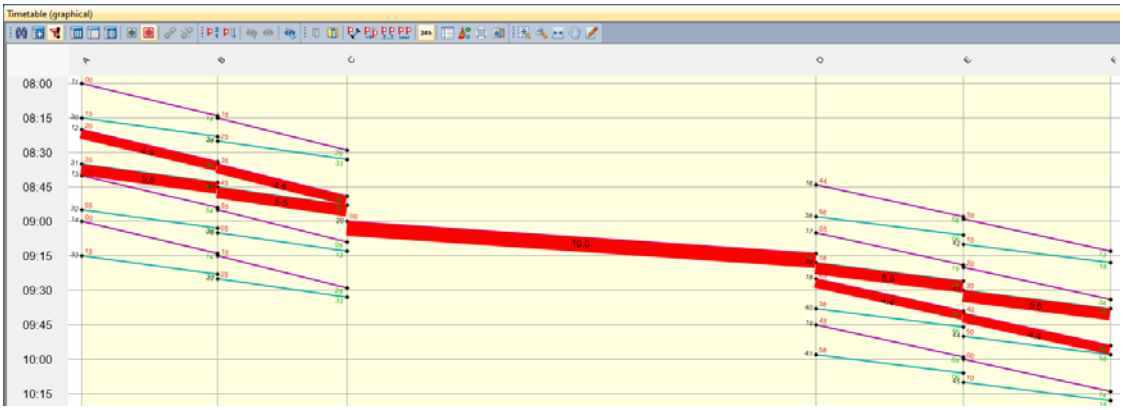
The calibration tool can be used for 4-step and Visem models.

1.5 Calculation of service frequency

In addition to journey time and the number of transfers, the service frequency is one of the most important quality criteria for public transport services. This makes it a decisive parameter for mode and route choice in traffic models. Due to its importance, the definition of service frequency for PTV Visum 2021 was adjusted to avoid unintuitive results.

Previously, the number of arrivals at the destination of the relation was counted, but now a graph (maximum flow method) is built for calculation purposes. The sum of the connections at the weakest point defines the service frequency. The definition thus follows the calculation in the headway-based assignment.

In the depicted example, two feeder connections to a central connection are given. The previous definition of the indicator would have provided a service frequency of "2". This value is still output as the new attribute "Number of arrival time points". The service frequency is now given by the minimum frequency of the central route and results in "1".



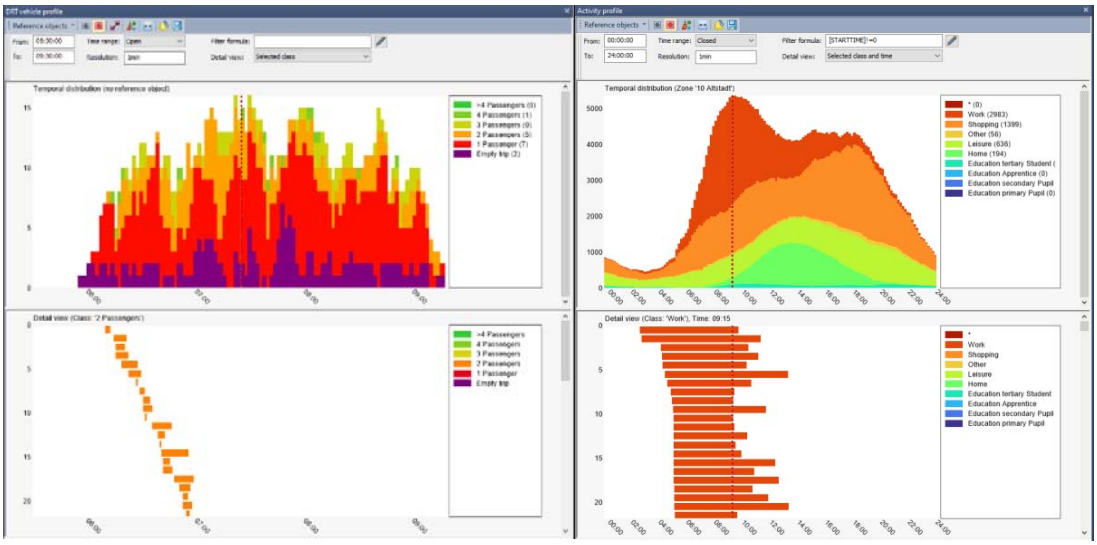
2 New analysis tools

2.1 Profiles (analysis of temporal distribution)

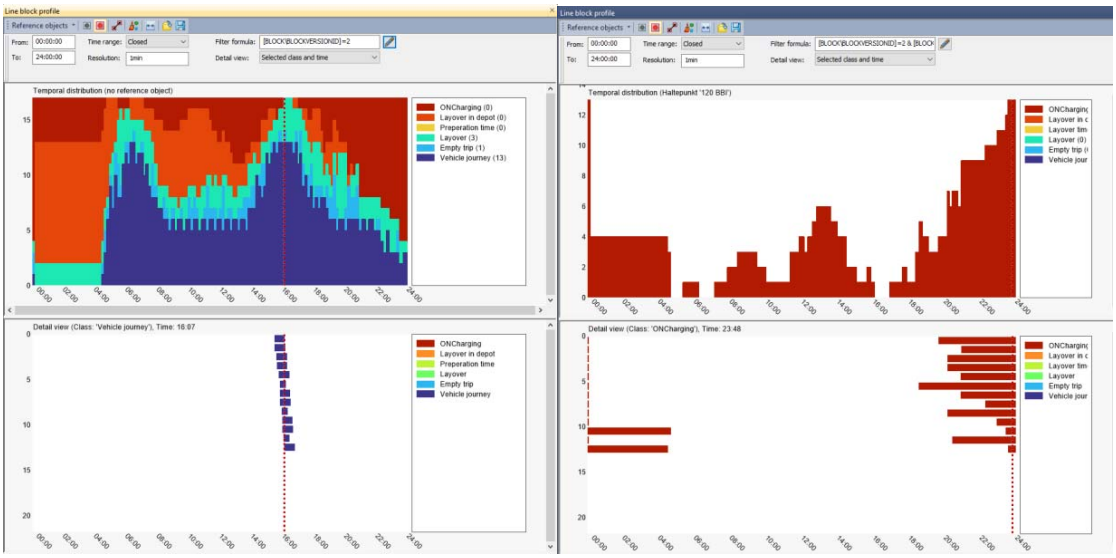
The profile view shows the temporal course of various activities. Activities can be line block items, timetable journeys, DRT tour legs or activities from ABM models. These activities have in common that they have a start and end time and that the location is known at both times. Individual activities are plotted on a time axis. Concurrent Activities are displayed one above the other so that the y-axis shows the number of simultaneous activities at each time point. You can classify the elements by choosing any attribute. The elements are then displayed sorted in the view according to their classifications. The spatial selection of activities is controlled by reference objects. The reference object filters the displayed objects according to their location.

A disaggregated view is available below the profile view. This “detail view” resolves the summary of the activities again and draws the individual activities separately.

The following figures show typical applications of the activity profile. The first figure shows the network-wide evaluation of the vehicles used in a ride-sharing system and their occupation over time. Directly next to it is an activity profile from an ABM model, which shows activity executions filtered over an inner-city district.

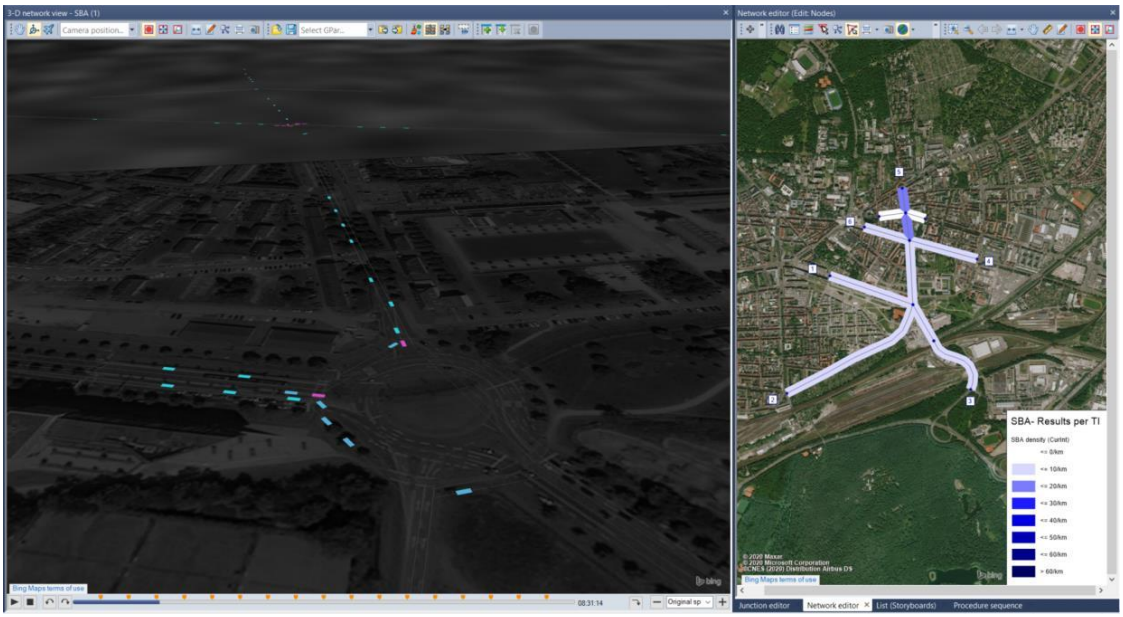


The following two figures show the results of a line blocking (vehicle scheduling). You use the line block profile view to visualize the activities of the vehicles used over time. Filtered by location and activity, you can see, for example, how many charging activities are planned at the same time and the same location.



2.2 Visualization of vehicles in SBA

The vehicles of a simulation-based assignment (SBA) can be visualized in a separate new view. The visualization is a tool that serves two important purposes: On the one hand, it helps to more easily identify network coding issues and to support calibration efforts. Second, it is the perfect tool for presentation purposes and to show SBA assignment results. Because the view is a special 3-D network view, you can also use the possibilities of recording .avi files using storyboards in this view.



A precondition for the visualization of vehicles is the recording of trajectories. For this purpose, there are new options for recording trajectories in the assignment parameters of the simulation-based assignment (SBA).

The recording is played immediately after opening the 'SBA visualization' view. The standard graphic parameters are set in a way that essential information can be captured quickly. The lengths of the vehicles correspond to their transport system, the color classification shows

their speed. The network is represented by the simulation graph, whereby the number of lanes is also shown. In the case of signalized nodes, the state of the signal head is also displayed.

The analysis of the assignment results and the testing of the network is supported by an easy navigation - both in terms of time and space. With the help of the playback control you can jump to any point in time and adjust the playback speed of the recording. The synchronization with other windows facilitates orientation in the network or zooming in to nodes of particular interest. You can make corrections to the network without hindrance. The simulation graph is only recreated when trajectories are recorded again. To save memory space, trajectories can optionally be discarded when closing the view.

3 Speed-up

3.1 PrT assignments

In this release, again, a significant acceleration for many procedures was achieved. The runtime savings depend on many factors and is not the same for all models. The following figures for time savings are calculated for some example networks.

Procedure	Variant	Time savings up to …
PrT assignment	Bi-conjugate Frank-Wolfe	47%
	Incremental	12%
PT assignment	Timetable-based	15%
Matrix estimation	TFlowFuzzy	12%
	Least Squares	41%
Filter	PT path and volume filter	60%
Flow bundle	PT	27%

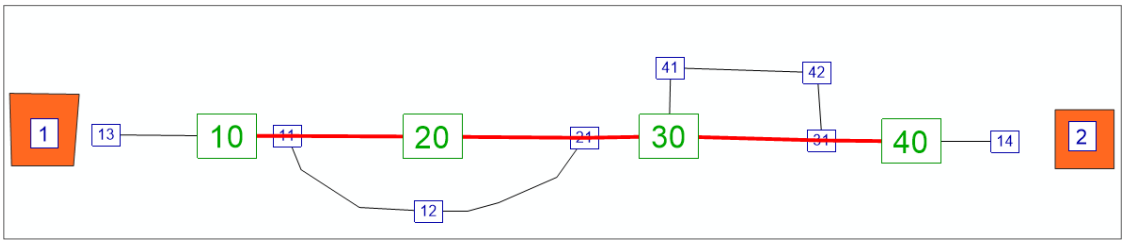
The memory requirements of the version files have been reduced. The savings can be up to 65% of the original memory consumption.

4 Improvements for Scenario Management

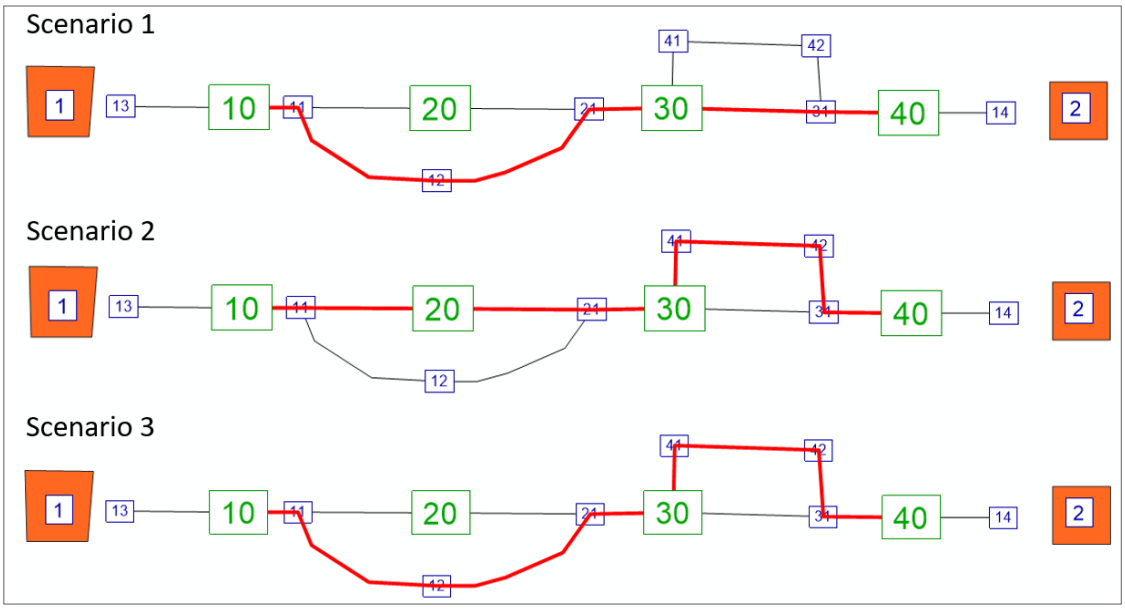
4.1 Combining independent course changes

The functionality for scenario management projects has been improved to enable projects in which changes to the PuT supply can be combined and correctly replicated in corresponding scenarios. More specifically, it is possibly to combine different modifications affecting the same route course if they are independent from each other. The improvements are demonstrated using the following example:

The network contains a bus line – displayed in red in the figure below – with four stops and several vehicle journeys. The study involves temporary re-routing of the bus line for two sections which are investigated as scenario management project.

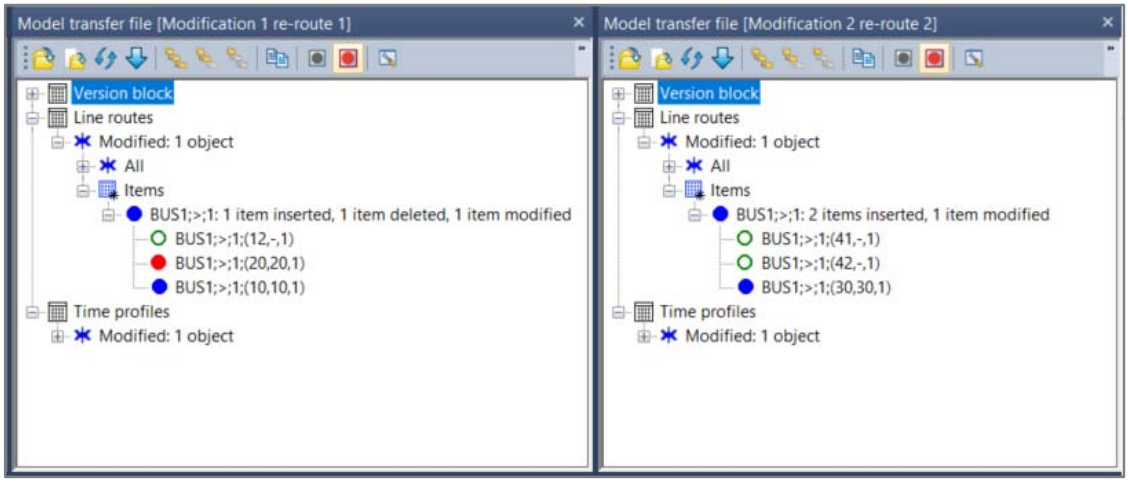


Due to the fact that re-routing of the different sections occurs over different time periods, the changes are modelled in two different modifications. Besides the base case there are three different scenarios: in scenarios 1 and 2 one modification is applied whereas in scenario 3 the two modifications are combined. The following figure shows the route courses of the bus in the three scenarios:



The combination of two modifications for the same line route – as shown in the third scenario – was not possible so far. By changing the content of the model transfer file the combination of independent modifications of the same course are enabled. More specifically, the model transfer file contains information of the changed part of a route only and consequently allow the model transfer file to be applied to an already modified network.

This can be seen in the View for model transfer files: on the left side you can see the changes for the first section via node 12 and on the right side the re-routing via nodes 41 and 42.



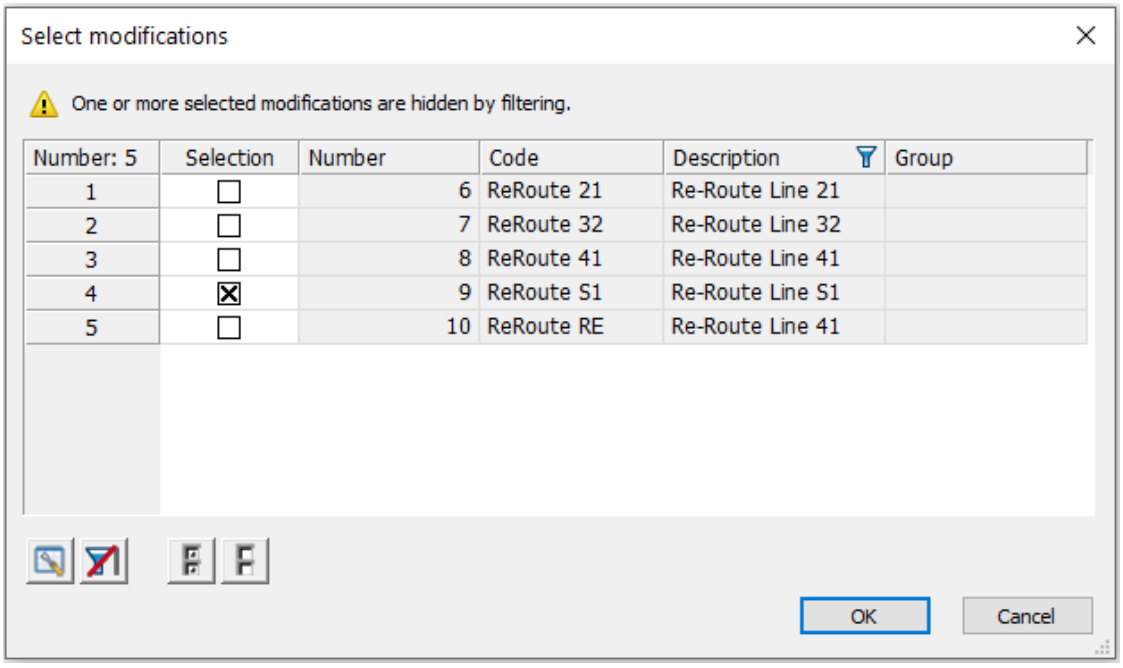
The required improvements apply to the entire data model of the line hierarchy. So far items were identified using indices.

In the same way, the changes to the model transfer file improve use cases involving changes to system routes and PrT paths. Also here, only information of the parts that have been changed is saved in the model transfer file.

Projects that have been created with previous versions of Visum can be converted by reloading and saving modifications.

4.2 Working with many modifications

In some projects the number of modifications can quickly inrease. Consequently, when allocating modifications to scenarios the selection of the corresponding modifications can become cumbersome. For this reason the dialog used to allocate modification to scenarios has been revised. For the selection of modifications arbitrary attributes of modifications can be displayed and column filters can be applied to reduce the number of modifications shown.


Select modifications
One or more selected modifications are hidden by filtering.
Number: 5
Selection
Number
Code
Description
Group
1 6 ReRoute 21 Re-Route Line 21
2 7 ReRoute 32 Re-Route Line 32
3 8 ReRoute 41 Re-Route Line 41
4 9 ReRoute S1 Re-Route Line S1
5 10 ReRoute RE Re-Route Line 41
OK
Cancel

5 Graphics and Handling

5.1 Save network file

It is important to generate data comfortable and quickly to exchange data between version files or other applications. This data exchange is supported by the new features implemented for saving network files, demand files and model transfer files as well as for creating version comparisons and exports form Visum to data bases. All related dialogs were enriched in their selection functionality for tables and attributes for tables.

The selection tree of the save network dialog looks like the one in the attribute selection dialog: the etries display an icon in front of every attribute displaying the status of occupany status and all subattributes are organized under one parent node. This grouping enables a quick selection of subattributes. It is for example possible to select all subattributes of the link attribute run time by public transport with one click. In addition, it is possible to display indirect attributes for all tables and select them as well.

Multiple attributes of a table can be marked with multi-selection (click+Ctrl or +Shift key). To comfortably select the attributes it is possible to use either the space bar, to select the checkbox or to use the context menu. The same selection process can be used also on the level of tables.

Once a table is deselected the previously adjusted attribute selecion is preserved. This feature supports to quickly recover previously adjusted attribut selections without saving them.

If the selected language for the user interface is not English, an option is offered to display all attribute names within the selection tree in English. This option allows to see the same attribute names in the dialog which will be later written to the created file.

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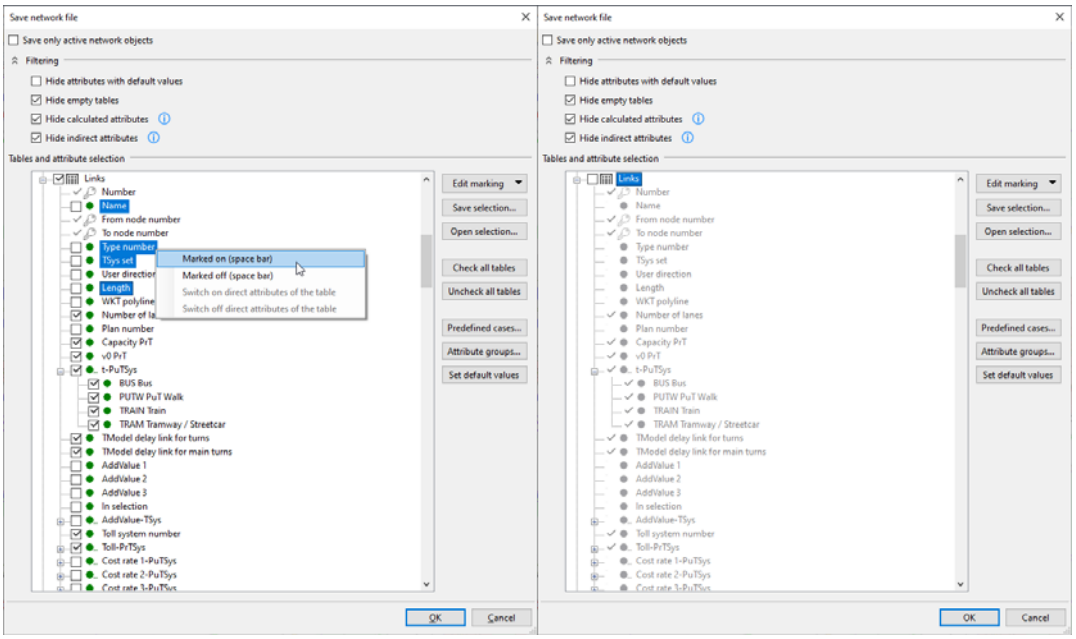
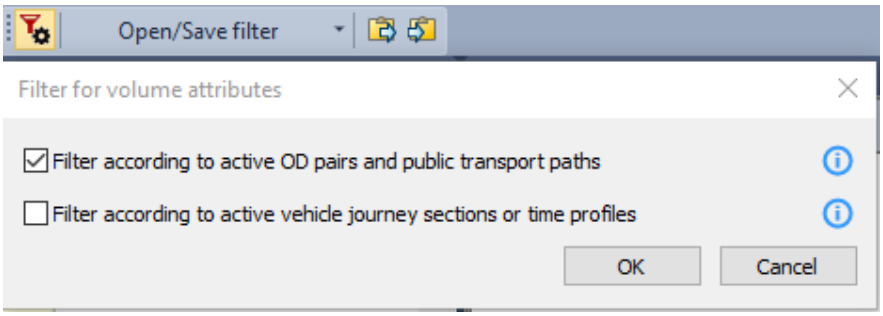


5.2 Volume attribute filter (PT)

The assignment of public transport demand to a filtered transport supply is based on connections that run entirely on the active supply. The volumes of the connections are input variables for the calculation of the PT operational indicators, for example, the passenger-kilometers. This calculation also takes a supply filter into account. However, up to now the selection only affected the supply, but not the demand-based indicators, which are still based on the allocated demand. This led to inconsistent results, especially if the filter criteria changed between apportionment and the indicator calculations.

The introduction of the volume attribute filter corrects this inconsistency. If the filter is activated, the values of indicators which take volume into account are reduced based on the active part of the supply. This means that only volumes that are based on an active timetable journey sections on the active day are included. The 'In selection' attribute is also effective here. Volumes are distributed to the journey sections according to the rule selected in the general process settings. If routes are only saved as routes and not as connections, the volumes are reduced based on the active time profiles.



The behavior of the load attribute filter is therefore very similar to the functionality ‘Filter network volumes’ which was previously found in the OD pair filter. Both filters can now be accessed as filter for volume attributes in the menu ‘Filters’ or via an icon of the toolbar for filters.

5.3 HBEFA – Creating fleet compositions

During the release of PTV Visum 2020 there was an Update to the lastest version of HBEFA, namely HBEFA 4.1 with a number of changes and updates. To also improve the work flow when using HBEFA in projects new functionality has been introduced. The objective is to make the use of HBEFA data more transparent.

The HBEFA data package can be downloaded automatically during the installation of PTV Visum. The HBEFA fleet data are now independent network objects and can be displayed in two new lists - HBEFA fleet compositions and HBEFA vehicle stratum. The standard options of using column filters in lists allows the view of the data to be restricted based on the application.

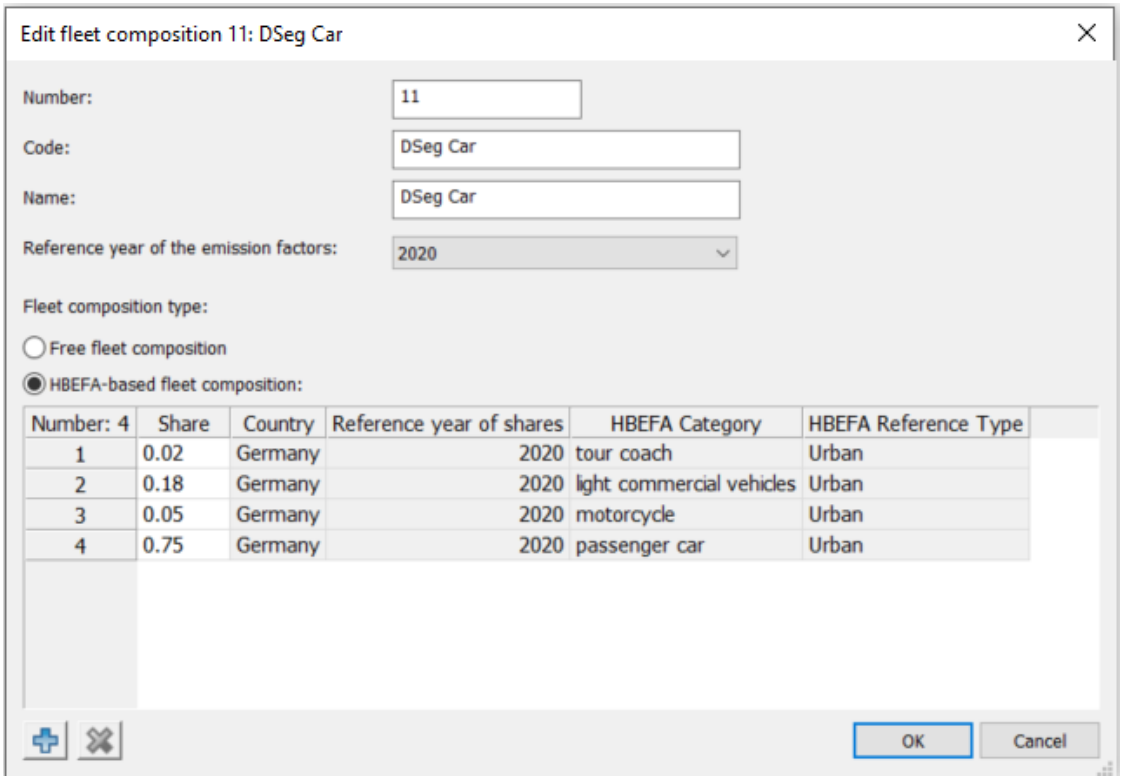
List (HBEFA fleet compositions)

Select list layout...

Number: 30	No	Name	RefYearShares	HBEFA_Category	HBEFA_ReferenceType	Country
1	4441	HBEFA41-GERMANY-2020-Coach-Average	2020	tour coach	Average	Germany
2	4442	HBEFA41-GERMANY-2020-Coach-Motorway	2020	tour coach	Motorway	Germany
3	4443	HBEFA41-GERMANY-2020-Coach-Rural	2020	tour coach	Rural	Germany
4	4444	HBEFA41-GERMANY-2020-Coach-Stock	2020	tour coach	Stock	Germany
5	4445	HBEFA41-GERMANY-2020-Coach-Urban	2020	tour coach	Urban	Germany
6	4446	HBEFA41-GERMANY-2020-HGV-Average	2020	mix (trucks, truck trailers, artic. trucks)	Average	Germany
7	4447	HBEFA41-GERMANY-2020-HGV-Motorway	2020	mix (trucks, truck trailers, artic. trucks)	Motorway	Germany
8	4448	HBEFA41-GERMANY-2020-HGV-Rural	2020	mix (trucks, truck trailers, artic. trucks)	Rural	Germany
9	4449	HBEFA41-GERMANY-2020-HGV-Stock	2020	mix (trucks, truck trailers, artic. trucks)	Stock	Germany
10	4450	HBEFA41-GERMANY-2020-HGV-Urban	2020	mix (trucks, truck trailers, artic. trucks)	Urban	Germany
11	4451	HBEFA41-GERMANY-2020-LCV-Average	2020	light commercial vehicles	Average	Germany
12	4452	HBEFA41-GERMANY-2020-LCV-Motorway	2020	light commercial vehicles	Motorway	Germany
13	4453	HBEFA41-GERMANY-2020-LCV-Rural	2020	light commercial vehicles	Rural	Germany
14	4454	HBEFA41-GERMANY-2020-LCV-Stock	2020	light commercial vehicles	Stock	Germany
15	4455	HBEFA41-GERMANY-2020-LCV-Urban	2020	light commercial vehicles	Urban	Germany
16	4456	HBEFA41-GERMANY-2020-Motorcycle-Average	2020	motorcycle	Average	Germany
17	4457	HBEFA41-GERMANY-2020-Motorcycle-Motorway	2020	motorcycle	Motorway	Germany
18	4458	HBEFA41-GERMANY-2020-Motorcycle-Rural	2020	motorcycle	Rural	Germany
19	4459	HBEFA41-GERMANY-2020-Motorcycle-Stock	2020	motorcycle	Stock	Germany
20	4460	HBEFA41-GERMANY-2020-Motorcycle-Urban	2020	motorcycle	Urban	Germany

When creating your own model-specific fleet compositions, a distinction is made between two types: the HBEFA-based or the free fleet composition. In a HBEFA-based fleet composition, only HBEFA fleet compositions can be combined with each other. The shares of different HBEFA fleet compositions are saved and can be edited later (see Figure below). However, the shares of subsegments, i.e. the vehicle strata, contained in these fleet compositions cannot be changed. Free fleet compositions one the other side can be created from scratch or from the HBEFA data. The fundamental difference to the HBEFA-based fleet compositions is that the shares of subsegments can be changed. Any references to the HBEFA data that are initially used to create the free fleet compostion are lost.

Typically, the demand segments in the model correspond to a combination of HBEFA fleet compositions. This applies, for example, to a demand segment Car, which is often composed of a combination of motor cycles, light commercial vehicles, passenger cars and possibly coaches in relation to the HBEFA data. This fleet composition can now be created as a HBEFA-based fleet composition, whereby the reference to the underlying HBEFA fleet compositions can be seen.



The creation of fleet compositions is supported by improved dialogs, in which the selection of the HBEFA data is also made easier by the use of column filters.

5.4 Format of list layouts

The format of list layouts has been changed to XML format. This enables editing of the file for special applications. The changed format has also been integrated into the global layout file.

6 Interfaces

6.1 Updates and extensions of PT Interfaces

The accurate import of public transport data from other systems is the basis for creating and updating a multimodal transport model.

The integration of the data into an existing traffic model poses two major challenges. The data must be formally converted to the PTV Visum data model. This results in an already georeferenced network model, which only contains the public transport data from one data source. The role of this formal convertion is taken over by the specific public transport data importers that use the standard formats (GTFS, HAFAS, railML® or VDV 452)

In a second step, these PTV Visum data must be merged into an existing traffic model. Integration of the timetable journeys and line blocks into an existing traffic model, which usually has a different network basis. The function "Import PuT supply from Visum" takes care about this task.

With PTV Visum 2021, data transfer from proprietary and standard formats has been extended. The VDV452 interface imports and exports line block information as well as forced chainings of timetable journeys and stop-specific stop times.

The HAFAS import supports the format 5.40.49 (status December 2019). In addition, the HAFAS import was extended by the takeover of the realgraph. Thus PTV Visum takes over information about georeferenced routes available in HAFAS data.

The railML Import process has been extended by retaining the passenger trip chains, even if the calender type has been change during import.

The function "Import PuT supply from Visum" contains the possibility to transfer line blocks from the source network.

6.2 Convert operating days in valid days

In operational public transport planning, it is common practice to model the timetable in terms of operating days. The operating day comprises the complete set of journeys and line blocks, but does not include any information about the sequence or transitions. The operating day is defined for groups of days such as Monday to Friday or Monday in holiday periods. In contrast, modeling in strategic transportation planning and in Visum is based on the definition of valid days. Using a 0/1 vector, valid days in Visum describe the calendar days on which a service runs. As a result of the different definitions, services are duplicated when transferring PT data from operative systems, more specifically when services in the operating system are allocated to several operating days. In order to eliminate redundancies and to support the valid day-based approach, several functions have been added in PTV Visum.

The function 'Aggregate vehicle journeys' combines identical vehicle journeys and allocates a valid day. The function 'Determine operating period' compares the valid days and attempts to determine common day validity over certain calendar periods. The use of operating periods can lead to a considerable reduction of the number of valid days. The function 'Connect line blocks' combines the line block versions that were initially based on the operating days from

operational systems using an evaluation and creates additional line block versions for longer periods than the operating day.

7 New and updated examples

Examples illustrate the scope and workflow of the most important functionalities in PTV Visum. They provide guidance on how to use functionalities in projects and give information on how the calculations work. The installation of the examples is offered during the installation of the program. You can access the examples from start page in Visum or via the menu ‘Help’. Since the last release, the following examples have been added or updated:

- Activity-based demand modelling

  An ABM generates a complete schedule with all activities and the associated trips for each person of the population. For this purpose, a synthetic population has been generated for the example, whose characteristics corresponds to the actual population. The example covers the calculation of the example model, the description of the ABM and explanation of the used program code.

- Strategic planning for e-Vehicles using vehicle scheduling

  The example demonstrates the requires steps to run the vehicle scheduling procedure with e-vehicles. The results are compared to an existing result with conventinal diesel buses only. Ranges and charging times of e-vehicles are considered too and analysed by a scenario comparisons.

- Modelling ride sharing systems

  The example demonstrates how to model a unimodal ride sharing system considering both the supply and the demand side. It explains the required settings in the procedure and evaluates some of the results.

- Ride sharing systems in demand models

  The example extends an already existing tour-based demand model. The steps described can easily be transferred to all other types of demand models. It describes the steps to integrate ride sharing as an additional mode in the demand model. Then it explains required changes in the demand calculation. Special attention is directed towards stability of results.

- Modelling autonomous vehicles (AV)

  The example demonstrates special characteristics of automomous vehicles and the consequences for highway assignments in macroscopic models. Besides the modelling steps required to integrate AV in static assignments the changes are also explained for considering AV in the simulation-based assignment (SBA).

- Dynamic matrix estimation for public transport

  The examples demonstrates a use case in public transport where the demand is adjusted based on link counts for different time intervals. The objective is that assignment results match the link counts.

- Emissions Calculation according to the Handbook of Emission Factors (HBEFA 4.1)

  The example shows an application of the emission calculation with HBEFA. Various pollutants and indicators are calculated for different demand segments including busses. The example is based on the latest HBEFA release.

- Analysis of accident data

In two new tutorials application for safety are demonstrated. It explains how accident data can be imported into an existing model and how both accident data and results from the transpotation model can be combined when analyzing data.

8 Technical topics

8.1 Python environment

PTV Visum 2021 will be the last release to provide a Python 2.7 environment for scripts and AddIns in addition to the 3.x environment. Future releases will only provide a Python 3.x environment. Please adjust your custom scripts and AddIns to Python 3.x in order to sustain compatibility with future releases.

All Add-Ins provided with PTV Visum 2021 are new using the Python 3.7. environment.

8.2 Installation

The installation process was changed in the sense that larger components (e.g. example files) are now only downloaded if requested by the user in order to reduce initial download size. This mechanism is also applied for integrating the optional installation of the HBEFA data packages into the program installation. A separate download and installation step is no longer required.

8.3 End of Life for older MS Windows Operating systems

The products of the PTV Vision Traffic Suite are supported and tested by PTV only on the Windows operating systems with active Extended Support by Microsoft. Details on the support lifecycle are provided by Microsoft in the Windows Lifecycle Fact Sheet.

According to these arrangements, PTV no longer supports the usability of the Vision Traffic suite products on MS Windows 7, MS Windows Server 2008 and MS Windows Server 2008 R2 operating systems. Windows 10 editions are only supported until their official service period terminates. Due to technical restrictions, support for some LTSC/LTSB editions cannot be provided for their full servie period.

8.4 CodeMeter Runtime

The CodeMeter Runtime environment has been updated to version 7.0.

PTV VISUM

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