Viriato – Software for railways
INTRODUCTION

Viriato is a powerful integrated timetable planning tool that allows users to optimise the railway planning process.

The new version of Viriato, launched at InnoTrans in 2012, completes a four year project to ensure the future of the product through the investment in a state-of-the-art software architecture and technology. Since SMA introduced Viriato in 1996, a number of additional modules, including geo-visualisation and demand forecasting, have been added, and we are proud to continue the ongoing development of the tool with our major new version.

Viriato integrates into the entire planning process:

- Strategic – Using high-level data to develop initial travel time estimates, rough timetables and rostering plans that optimise vehicle utilisation. Viriato helps planners identify optimal timetables by allowing them to easily compare alternatives.
- Capacity – As timetable implementation approaches, Viriato can work with detailed data to refine and share timetables between stakeholders.
- Operations – Daily timetables can be prepared for use by train operators and infrastructure managers.

Viriato provides timetable planners with a full suite of applications addressing all aspects of the timetable planning process. The Viriato interface consists of the graphic timetable, travel time analysis, conflict detection, network diagrams, platform occupation charts and customer timetables in addition to data manipulation features.

Large amounts of detailed data can be used to prepare precise plans to maximise network capacity and identify cost efficient strategies for eliminating bottlenecks.

Viriato is a complete timetable planning application that helps timetable planners quickly, accurately and transparently develop optimal timetables for all levels of operations. Thanks to its unique features, it has established itself as an integral part of the timetabling process at more than 90 companies in 15 countries.

Timetable planning at your fingertips
Viriato is the only planning tool that covers the full planning process from the strategic through to the operational level. It achieves this through the use of a top-down or “service-centric” methodology where you can freely think about the train services that you want to run before aligning them with the constraints of the network.

Viriato excels at developing timetables based on coordinated regular interval services. These timetables provide passengers with excellent services, but are very complicated to develop and evaluate by hand; Viriato was created explicitly for regular-interval timetables and integrates this concept fully throughout the application.

Unlike other planning tools, you work at a level of data granularity appropriate for the task. A feature-orientated data model lets you concentrate on planning trains and then adding more detailed information later in the process.

Having the appropriate level of infrastructure data for the current task relieves the train planner from maintaining an overly detailed infrastructure model where unnecessary information has to be entered and managed. As the timetable implementation date approaches, Viriato can work with increasingly detailed data to refine the plan. This prevents the planner from being constrained by having to create an unnecessarily detailed model for the task they are working on.

Viriato consistently follows these principles to enable train planners to develop their plans, and understand any constraints on their services at an earlier stage than would otherwise be possible. This ensures that Viriato provides the maximum possible information to the train planner at each stage in the process, from conceptual design through to production-ready timetables.

Planners can design efficient timetables, allowing them to easily compare alternative scenarios and identify where changes have been made.
In autumn 2012 SMA successfully completed a four year project to redevelop Viriato in C#.NET. Rewriting Viriato from scratch in the new software framework ensured the future viability of the product. The new object-oriented architecture offers significantly higher performance and better scalability for very large railway networks. It also allows the integration of new user-specific functionality in a consistent manner.

The new version of Viriato includes a range of improvements that significantly increase the efficiency of the timetable planning process:

- The user interface has been made consistent throughout the entire program, and the workflow has been improved with the information required on each screen made directly available to the user.
- The user can add additional attributes to the planning database allowing them to incorporate their own operational requirements.
- The addition or modification of data on any screen instantly displays in all views, allowing the planner to visualise and manage the timetable development process as they are working.
- The addition of an undo feature allows the planner to experiment with alternatives, and to quickly correct any non-optimal changes made.
- The graphic timetable can be edited directly, and the user may retime whole or partial trains simply through selecting the relevant portion of a service.
- Conflict detection enables the user to eliminate conflicts dynamically simply by dragging trains on the graphic timetable or platform occupation view.
- User-defined reports allow detailed queries of timetable data to be produced in tabular and graphical formats.

An optional enterprise module significantly enhances use of Viriato as an operational planning system. Date-specific infrastructure layouts can be created allowing route restrictions due to maintenance etc. to be planned. Repeating pattern trains can also now be modified individually allowing the planning benefits of train families to be kept, while allowing the flexibility needed to run an operational railway.
Viriato has been designed with a modular architecture allowing the user to work with the features that are required for the planning task that they are undertaking. As more detail outputs become necessary, additional modules can be seamlessly integrated into the program.

**Standard features:**
- Netgraph – service-centric view of timetable showing service frequencies and routes
- Graphic timetable – visualisation of train service and interaction between trains
- Customer timetable – tabular presentation of timetable
- Calendar – set running day patterns to allow timetable variants by day
- Reports and add-ons – analyse the timetable with user-created reports and graphs

**Optional features:**
- Running time calculation – calculate precise technical running times
- Platform occupation – view station utilisation and resolve capacity constraints
- Conflict detection and resolution – verify compliance of the timetable with infrastructure constraints
- Vehicle rostering – prepare detailed plans of fleet utilisation and maintenance tasks
- Trip time analysis – display the journey time between locations including change times

Sometimes the planning workflow process will have specific additional requirements not covered by the standard features of Viriato. For these cases SMA has extensive experience in developing interfaces to other management information systems.
The introduction of coordinated ("clock-face") timetables has led to the ability to represent timetables in a way that shows both the geographical network and the train times in an efficient manner on a "netgraph". A single line represents each service (and the corresponding journey in the reverse direction) connecting the stations it passes through on its trip, with the arrival and departure times for each station indicated. The repeating aspect of the timetable means that a whole repeating family of trains can be covered by one line on the diagram. The connection times between services at a station can be seen at a glance, giving a powerful method for improving the coordination between services for the train planner.

Viriat was the first planning tool to successfully combine this netgraph with graphic and tabular timetables to produce a single integrated planning tool.

Focusing on service

Functionality

- Fully integrated with the main planning database – change train data in one location and it changes in all Viriato screens immediately
- Step-by-step undo function (to last saved version)
- Powerful snap-to-grid mechanism supports the user in the efficient drawing of netgraphs with a visually compelling layout
- Advanced drawing functions for legends, comments, etc. allow the production of ready-to-print netgraphs
- Grouping of multiple trains on common sections (e.g. to display an hourly service of several different trains with two-hourly frequency over the same route) to maintain visual clarity

Display/output

- Directly work with trains in the netgraph
- Select trains for analysis and illustration using specific day filters
- Create easy-to-read line maps
- Import and export data between different Viriato databases
- Separation of views for display on screen and for printing
- Copy netgraph to clipboard or export it directly to a graphics file (including *.png, *.emf)
Graphic timetables represent train operations and are pivotal when determining the interactions between trains at a network-wide level. Graphic timetables can also be used to identify the likely rolling stock requirements for a line and produce initial utilisation plans.

An experienced timetable planner can assess the feasibility of a timetable and the plan, such as insufficient headways between services or conflicting movements over a single track section simply by looking at a graphic timetable.

Viriato’s highly configurable graphic timetable functionality allows users the freedom to define only the elements that they require. For example, colours may indicate different train types (e.g. by service group or line), while line thickness may reflect express or regional service. Such customisation gives timetable planners the power to produce highly descriptive graphical timetables, and to identify timetable improvements.

Functionality

- Fully integrated with the main planning database – change something in one location and it changes in all Viriato screens immediately
- Create graphic timetables for selected line segments
- Directly open a graphic timetable from the train window (for the entire trip or part of a trip)
- Shift a train (or a part of train) using drag-and-drop in the graphic timetable
- Directly edit a train within a graphic timetable
- Step-by-step undo function (to last saved version)
- Compare alternatives by overlaying different scenarios
- Select trains using filters for operating days and validity periods

Display/output

- Display trains for selected time periods of up to 24 hours
- Use colour to distinguish between train type or status
- Select timetable orientation, scaling with mouse wheel
- Free selection of display layout, colours, fonts, etc.
- Highlighting of the tracks used in line diagram
- Advanced tooltip to instantly display train details
- Train number of each train always visible in the displayed view
- Selectively display time information (arrival, departure, passing), train characteristics and footnotes
- Copy graphic timetable to clipboard or export it to a graphics file (including *.png, *.emf)
<table>
<thead>
<tr>
<th>S (1)</th>
<th>IR</th>
<th>IR</th>
<th>S (1)</th>
<th>S (21)</th>
<th>IR</th>
<th>S (1)</th>
<th>S (1)</th>
<th>S (21)</th>
<th>IR</th>
<th>ICN</th>
<th>S (1)</th>
<th>S (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>22123</td>
<td>2305</td>
<td>2257</td>
<td>21119</td>
<td>21113</td>
<td>20215</td>
<td>2307</td>
<td>21123</td>
<td>22125</td>
<td>22129</td>
<td>20219</td>
<td>2309</td>
<td>10013</td>
</tr>
<tr>
<td>15</td>
<td>17</td>
<td>17</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>16</td>
<td>16</td>
<td>15</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>6:30</td>
<td>6:31</td>
<td>6:45</td>
<td>7:01</td>
<td>7:15</td>
<td>7:29</td>
<td>7:45</td>
<td>801</td>
<td>7:43</td>
<td>7:59</td>
<td>7:44</td>
<td>801</td>
<td></td>
</tr>
<tr>
<td>6:34</td>
<td>6:35</td>
<td>6:49</td>
<td>7:07</td>
<td>7:09</td>
<td>7:34</td>
<td>7:49</td>
<td>807</td>
<td>7:49</td>
<td>807</td>
<td>7:50</td>
<td>807</td>
<td></td>
</tr>
<tr>
<td>7:04</td>
<td>6:59</td>
<td>7:27</td>
<td>7:38</td>
<td>7:38</td>
<td>7:38</td>
<td>7:38</td>
<td>7:38</td>
<td>7:38</td>
<td>7:38</td>
<td>7:38</td>
<td>7:38</td>
<td></td>
</tr>
</tbody>
</table>

Locarno [2] 16

Lugano [1] 17
The customer timetable is the traditional method for presenting the schedule of trains along a route. Indeed, its structure is reflected in the etymology of the word timetable itself, which refers to the tabular presentation of times. Despite its long history, the new customer timetable in Viriato has increased its capabilities. Used in conjunction with the operational modules, such as the graphic timetable, it provides further insights into aspects of the timetable on rail traffic.

Timetables also form a clear legal description of the service in terms of product type, coverage, frequency and/or station calling pattern policy, and are thus indispensable. The functional requirements for a customer timetable vary depending on how it will be used.

Viriato provides flexible filter possibilities and layout settings that permit users to easily display the desired information. Viriato also provides an interface that allows customer timetable data to be analysed and/or displayed using MS Excel.

### Functionality
- Prepare customer timetables for selected line segments or combinations with branches
- Directly edit trains from the customer timetable
- Step-by-step undo function (to last saved version)
- Select trains using filters for operating days and validity periods
- Show the overtaking of trains
- Indicate validity changes in a train’s operation
- Interface with MS Excel

### Display/output
- Display timetables for selected time periods of up to 24 hours
- Select display of arrival, departure and passing times
- Individually show/hide trains in the timetable
- Use colour to distinguish between train type or status
- Freely select display layout, colours, fonts, etc.
<table>
<thead>
<tr>
<th>Mon</th>
<th>Di</th>
<th>Mi</th>
<th>Do</th>
<th>Fr</th>
<th>Sa</th>
<th>So</th>
</tr>
</thead>
<tbody>
<tr>
<td>Januar 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Februar 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>März 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>April 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mai 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juni 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juli 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>August 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>September 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oktober 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>November 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dezember 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Januar 2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Februar 2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>März 2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>April 2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mai 2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juni 2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juli 2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>August 2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
At the conceptual planning level a nominal day can be used to develop and evaluate timetables; however, as the date of timetable introduction draws near, planners must define the timetable in greater detail to include weekend variations and other service pattern alterations. Actual operations require day-specific timetables to allow responses to short-term changes, such as additional or cancelled trains, to be incorporated in the working plan.

Viriato’s calendar module allows timetable planners to assign date-specific validity to all trains in an interval-train family, individual trains in an interval-train family and/or single trains. The calendar enables the use of all types of validity possibilities within a single timetable. Examples include weekdays, weekends, the definition of specific days when the service operates, and days without a service.

### Functionality
- Display and analyse operations for any individual calendar date or selection of dates in the netgraph, graphic timetable, customer timetable, station track occupancy plan and arrival/departure tables
- Accurately calculate performance figures based on the calendar-based schedule (e.g. train kilometres, number of departures from a station, etc.)
- Use Viriato’s perpetual calendar to define holidays that change dates every year (e.g. Easter)

### Display/output
- Use calendar view to easily define operating/non-operating days by clicking on the required days using the mouse
- Automatically generate validity descriptions for footnotes in schedules
Leverage your data

The timetable prepared in Viriato contains detailed information about the operational characteristics of the railway. Viriato has built-in reporting capabilities allowing the user to produce high quality outputs of this timetable data. Customer-specific reports can now be easily generated providing a summary of the data shown in both tabular and graphical formats. Through an interface with SMA’s Netvisio, Viriato can also summarise data on route maps based on data in the timetable database.

The migration to the .NET framework also provides improved performance for users, and the option of adding new functionality quickly through an extension mechanism. By interfacing with the service layer within the Viriato application, further capabilities can be added that efficiently and safely manipulate timetable data.

Additional modules can be developed to satisfy the specific requirements of individual customers.

Functionality

- Create and save tabular reports based on a large number of timetable data queries
- Export timetable data to Netvisio to allow visual representation of timetable (including frequencies, stops, etc.)
- Set global project settings for a uniform, CI-compatible layout of documents
- Set local workplace settings for individual user working environment
- Define free train or infrastructure attributes
- Copy/paste function to MS Excel for all list views

Display/output

- Print high quality formatted reports directly from the built-in report engine
- Export data from the report engine in a variety of formats (including *.pdf, *.xls, *.tiff)
Accurate train planning requires a detailed knowledge of a train’s technically feasible running time. The ability to dynamically recalculate the running time during the planning process is essential. This allows changes in rolling stock and infrastructure, such as temporary speed restrictions for engineering works, to be included in the timetable. Viriato now makes it possible to calculate precise running times based on a wide range of technical and operational parameters.

The new running time calculator in Viriato includes the algorithm used by Swiss Federal Railways (SBB) to calculate all their running times in Switzerland. This calculator allows an unlimited combination of rolling stock types, traction values, dynamic resistances and braking curves to produce highly accurate running times which have been validated by SBB during their daily operations.

The civil engineering characteristics of the infrastructure such as gradients, curvature and speed restrictions are entered to produce a highly detailed model of the railway.

The Viriato running time calculator includes a library of tractive-effort/speed curves for common engines from several European railways, and easily allows users to define their own rolling stock types.

The new Viriato running time calculator integrates fully into the train planning process, and the results are instantly reflected in a train’s running times.

**Functionality**
- Validated industry standard running time calculation engine
- Fully integrated into Viriato
- Gradients, tunnel and curve resistance information
- User-defined direction and track-specific speeds
- User-defined station-specific entry and departure speeds
- Train configuration changes during train run (e.g. adding or removing vehicles to the consist)
- User-defined parameters for energy-saving operating techniques
- Tractive-effort/speed values from Viriato’s extensive library or user-defined values
- Significantly increased performance combined with additional calculation parameters

**Display/output**
- Diagram illustrating line speed and train speed with optional display of gradients and curve profile
- Train line in diagram showing head, middle or rear of train or both head and rear
- Log file recording all calculated parameters including energy consumption
- Travel time data can be directly transferred to Viriato’s train definition
Stations are at the heart of railway operations. Here lines converge, trains arrive and depart, passengers come and go and change trains, and trains are taken out of service, cleaned and maintained. As train operators introduce regular interval timetables and develop major connection points, the operational functions and capacity requirements placed on stations increase significantly.

Given these conditions, every step must be planned in detail. Therefore the analysis of the allocation of platforms, their occupancy and the arrival/departure times are a core part of the timetable production process. The questions that are addressed in this analysis include: Are there sufficient platforms available for the proposed service concept? And what additional tracks or switches are needed to increase the service?

Viriato’s platform occupancy module provides timetable planners with a simple and powerful tool for planning, evaluating and producing platform occupation charts. The planner can drag and drop trains between platforms and review conflicting moves instantly.

Viriato can also automatically resolve conflicts in station areas and create conflict-free platform workings with the optional conflict detection module.

Functionality
- Define track-specific occupancy and duration
- Set line-specific standard defaults and individual restriction rules for track allocation
- Set track-specific stopping points and arrival/departure speeds (for use in travel time calculation)
- Interactively allocate track using drag-and-drop within the allocation diagram
- Working area allowing trains without platforms to be kept in a separate pool until graphically assigned a platform
- Step-by-step undo function (to last saved version)
- Use filters for operating day, date range and validity
- Work directly with a train from the allocation diagram

Display/output
- Display/print station diagrams with tracks, platforms and lines
- Display the operating sequence in the station with slide control
- Adjust display based on operating day, train number, times, directions
- Freely select colours for displaying trains
- Copy graphic timetable to clipboard or export it to a graphics file format (including *.png, *.emf)
CONFLICT DETECTION

The dark side of capacity

A railway timetable is subject to numerous constraints, including those due to infrastructure (line headways, interlocking systems, etc.), vehicles (performance, train type, etc.) and the service pattern (intermediate stops, connections, etc.). The higher the railway system’s degree of complexity, and the closer to operating at design capacity, the more these constraints must be considered in timetable planning.

In complex cases it can be very difficult to verify that all the constraints on operation have been considered and that the proposed timetable remains conflict-free.

Viriato’s new conflict detection module rapidly determines and visualises all conflicts on the graphic timetable. The user can alter a planned train by dragging the path on the graphic timetable, and any remaining conflicts are instantly shown. Viriato produces a tabular summary of conflicts and durations to enable the planner to resolve them quickly.

The new Viriato conflict detection module also detects and automatically resolves platform allocation issues. Our rigorous mathematical algorithm produces a conflict-free platform occupation plan, and alerts the user if the proposed service pattern is infeasible, providing a valuable early warning to the train planner.

**Functionality**
- Distinguish between single direction and bi-directional service on a line
- Detect crossings on single track lines
- Detect itinerary conflicts in station gridirons
- Detect insufficient headway times based on user-defined headway standards
- Set station-specific separation times for conflicting routes and overlap distances
- Examine simultaneous track allocations, platform lengths and prohibited routes
- Dynamic drag-and-drop conflict resolution

**Display/output**
- Graphic display of conflicts on the track occupancy diagram and graphic timetable
- Tabular conflicts listing including conflict duration and affected trains
Viriato’s rostering module supports timetable planners over the entire range of planning from strategic long-term to detailed short-term studies and allows users to gradually refine them from the strategic to detailed level using the same database. It enables timetable planners to quickly and efficiently prepare rostering plans for timetable concepts developed using Viriato. The rostering module takes individual trips from the Viriato database and combines them into plans for a set of vehicles over a period of time (e.g. daily or weekly rostering plans).

The module also provides timetable planners with a simple and intuitive graphic editor, and features an automatic roster generation algorithm to minimise the number of vehicles required to deliver the timetable.

Timetable planners must consider many constraints when preparing detailed operations and rostering plans. These include vehicle-specific and station-specific constraints. Viriato’s rostering permits integrated validation checks (e.g. geographical breaks, turnaround times and maintenance tasks), and can estimate the costs associated with operating the vehicle rosters and output detail statistics about the roster.

### Functionality
- Create vehicle rosters through drag-and-drop
- Automatically generate efficient rosters using built-in optimisation engine
- Define empty vehicle movements
- Create detailed vehicle and station operational activities
- Define maintenance tasks and frequencies
- Assign cost functions for operational and maintenance activities

### Display/output
- Prepare vehicle rosters as Gantt charts
- Graphically display where validation rules have been violated and identify the type
- Print high quality vehicle rosters
- Output summary statistics for the number of vehicles utilised, the cost to operate the roster and evaluate alternative rostering plans
Timetable production is an interactive process involving many constraints and conflicting goals. Operational constraints often have impacts that are not initially obvious. Furthermore, the system-wide impacts of local timetable changes are not directly evident in large railway networks.

Viriato’s trip time analysis module enables timetable planners to compare alternative timetables and analyse timetable and service quality. It starts by identifying all meaningful connections based on the timetable data, trip times and user-defined transfer times. Once the connections have been identified, Viriato calculates the alternative’s most important customer and operational qualities.

The trip time analysis module provides many different analysis tools enabling timetable planners to thoroughly evaluate alternative timetables, and permitting the attractive presentation of this data in a variety of graphical formats. This allows the travel opportunities offered by the new timetable to the railway and its customers to be communicated effectively.

**Functionality**

- Determine all possible connections with: shortest trip time, fewest transfers and shortest weighted trip time, for any selection of origin/destination pairs
- Compare summary and specific origin/destination pair journey time data between timetables
- Set user-defined transfer weighting values

**Display/output**

- Display connection data in a tabular format for a large set of criteria (including trip time, waiting time, total distance travelled, speed, etc.)
- Use filters to display selected data
- Aggregate data based on various criteria
- Graphically view results in the SMA geo-visualisation tool
A train timetable goes through many planning stages over its long period of development. The process starts with the preparation of a draft service plan. This is constantly refined until operations of the train commence. Finally, after the introduction of the timetable system performance is analysed. Finding the timetable that best balances the railway’s operational and economic needs requires much iteration.

Viriato’s versatility enables it to support timetable planners at all stages of the development process. Nevertheless data will almost certainly need to be exchanged with other applications at some point in the process, and used either in parallel or sequentially. A central element in the data exchange process is ensuring efficient data flow without wasteful and error-prone re-collection of data. The challenge consists of linking different applications over intelligent and standardised interfaces.

The RailML initiative was created to improve the data exchange process between railway information technology applications (www.railml.org) through the development of agreed standards. SMA und Partner AG was a founding member of the RailML initiative and continues to actively participate in RailML development. The goal of RailML is to link different applications through the creation of defined interfaces between diverse rail service planning and operations IT applications, and to simplify information exchange with the definition of standardised XML-based schemas.

**Open interfaces**
- Direct exchange of data between all Viriato databases
- Support of the RailML standard for timetable data
- Full RailML 1.1 and 2.0/2.1 import and export
- Direct export to MS Excel

**Proprietary interfaces**
- SYFA (Swiss timetable database)
- PPSFR (DB vehicle rostering planning for passenger service)
- TPN (DB network slot portal for ordering train paths)
- TRANSFHOR (supply of the operational CTCs of REFER with the current timetable data)
- THOR (timetable system of RFF)
- CAPMAN/BookIN (slot portal of SNCB and Infrabel)
- LIIKE (slot portal of Finnish Transport Agency FTA)
- PCS (path coordination system of RailNetEurope)
- NeTS (timetable construction system of SBB)
- KIS (customer information system of RhB)

**System recommendations**
- **MS Access**
  - Recommended for stand-alone installations and small work groups
  - Provides flexibility and simple administration
- **Oracle/SQL**
  - Recommended for multi-user work groups
  - Provides high level of data security and performance
  - WAN-compatible
  - Flexibility for local work on mobile clients under MS Access using data extract and synchronisation functions
  - User concept: 4-level authorisation for Viriato functions (administrator, super-user, guest), timetable database owner provides authorisations for use (write, read, no access)
- **Citrix**
  - Citrix-compatible for operation on an application server
References

- ADIF Administrador de Infraestructuras Ferroviarias, Madrid (ES)
- AKN Eisenbahn AG, Kaltenkirchen (DE)
- AMMT Agenzia Mobilità Metropolitana, Turin (IT)
- asa AG, Rapperswil-Jona (CH)
- Canton of Fribourg, Fribourg (CH)
- Canton of Neuchâtel, Neuchâtel (CH)
- Canton of Ticino, Bellinzona (CH)
- Canton of Valais, Sion (CH)
- Canton of Vaud, Lausanne (CH)
- Chiltern Railways, London (UK)
- Citec Ingénieurs Conseils SA, Geneva (CH)
- CJ Chemins de fer du Jura, Tavannes (CH)
- COWI Hungary Consulting and Planning Ltd., Budapest (HU)
- DB Fernverkehr AG, Frankfurt a. M. (DE)
- DB Netz AG, Frankfurt a. M. (DE)
- DB Regio AG, Frankfurt a. M. (DE)
- Egis Rail, Guyancourt (FR)
- ETC Transport Consultants GmbH, Berlin (DE)
- Ferbritas SA, Lisbon (PT)
- FNM Ferrovienord SpA, Milan (IT)
- FTA Finnish Transport Agency, Helsinki (FI)
- Itstarr, Villeneuve d’Ascq (FR)
- INECO SA, Madrid (ES)
- Ingerop Conseil et ingénierie, Courbevoie (FR)
- Jungfrau Railways, Interlaken (CH)
- Keolis, Paris (FR)
- Kompetenzzentren ITF NRW, Bielefeld (DE)
- LVVG Landesnahverkehrsgesellschaft Niedersachsen mbH, Hanover (DE)
- Lucchini – Mariotta e Associati SA, Ponte Capriasca (CH)
- LVS Landesweite Verkehrsservicegesellschaft Schleswig-Holstein, Kiel (DE)
- Metron Verkehrsumplanung AG, Brugg (CH)
- Millennia Systems, Inc., Los Angeles (USA)
- Ministerium des Innern für Sport und Infrastruktur Rheinland-Pfalz, Mainz (DE)
- MOBgolden Pass Services, Montreux (CH)
- MVV Münchner Verkehrs- und Tarifverkehrsgesellschaft GmbH, Munich (DE)
- Nahverkehr Rheinland GmbH, Cologne (DE)
- Net Engineering, Monselice (IT)
- NSB AS, Oslo (NO)
- NVB Nordverkehrsgesellschaft Baden-Württemberg mbH, Stuttgart (DE)
- NVS Nahverkehrsgesellschaft Thüringen mbH, Erfurt (DE)
- NVV Nordhessischer Verkehrsverband, Kassel (DE)
- NWL Nahverkehr Westfalen-Lippe, Bielefeld (DE)
- ÖBB Österreichische Bundesbahnen, Innsbruck (AT)
- Plateway Pty Ltd, Clyde (AU)
- ProRail, Utrecht (NL)
- PTN Passenger Transport Networks, York (UK)
- REFER Rede Ferroviaria Nacional, Lisbon (PT)
- RegionAlps SA, Martigny (CH)
- Région Rhône-Alpes, Lyon (FR)
- Regione Lombardia, Milan (IT)
- RFF Réseau Ferré de France, Paris (FR)
- RFI Reti Ferroviarie Italiane, Rome (IT)
- RhB Rhaetian Railway, Chur (CH)
- Rigi Railways, Vitznau (CH)
- RMV Rhein-Main-Verkehrsverband GmbH, Hofheim a. Ts. (DE)
- Roma Servizi per la Mobilità, Rome (IT)
- RWTH Aachen, VIA, Aachen (DE)
- SBB Swiss Federal Railways, Bern (CH)
- Setec Ferroviaire, Paris (FR)
- SNCF/NMBS Société Nationale des Chemins de Fer Belges, Brussels (BE)
- SNCF Conseil, Paris (FR)
- SNCF Société Nationale des Chemins de Fer Français, Paris (FR)
- Swiss Federal Institute of Technology, ZURICH (CH)
- Swiss Federal Institute of Technology, LAUSANNE (CH)
- Swiss Train Paths Ltd, Bern (CH)
- Systra, Paris (FR)
- Széchenyi István University, Győr (HU)
- TMR Transports de Martigny et Régions SA, Martigny (CH)
- TPC Transports publics du Chablais, Aigle (CH)
- TPF Transports publics franco-bourgeois, Fribourg (CH)
- TRAVYS SA, Yverdon-les-Bains (CH)
- Trenitalia SpA, Rome (IT)
- Trenord S.r.L., Milan (IT)
- TRN Transports publics neuchâtelois SA, La Chaux-de-Fonds (CH)
- University of Berlin, Berlin (DE)
- University of Gelsenkirchen, Gelsenkirchen (DE)
- University of Nuremberg, Nuremberg (DE)
- University of Parubice, Pardubice (CZ)
- University of Prague, Prague (CZ)
- University of Science and Technology Trondheim, Trondheim (NO)
- University of Stuttgart, Stuttgart (DE)
- University of Trieste, Trieste (IT)
- V/Line Passenger Pty Ltd, Melbourne (AU)
- VBB Verkehrsverband Berlin-Brandenburg, Berlin (DE)
- VGN Verkehrsverband Grossraum Nürnberg, Nuremberg (DE)
- VMV Verkehrsverbund Mecklenburg-Vorpommern mbH, Schwerin (DE)
- VR Group Ltd, Helsinki (FI)
- VRR Verkehrsverband Rhein-Ruhr AöR, Gelsenkirchen (DE)
- VRS Verkehrsverbundsgesellschaft Saar mbH, Saarbrücken (DE)
- VVT Verkehrsverbund Tirol, Innsbruck (AT)
- Zweckverband SPNV Münsterland, Münster (DE)

- Millenia Systems, Inc., Los Angeles (USA)
Viriato – Software for railways