IVU.rail
INTEGRATED SCHEDULING, DISPATCHING AND OPTIMIZATION
IVU MAKES INTEGRATED RESOURCE SCHEDULING AND DISPATCHING EFFICIENT AND EASY.

All scheduling and dispatching processes for personnel and vehicle deployment in one universal system.

Efficient, rule compliant deployment of a public transportation company’s most important resources – its staff and vehicles – is key to realizing reliable and cost-effective operations. In the past, paper and pencil, as well as magnet boards, were chiefly used for this purpose. Later on came computer programs that were tailored to specific procedural steps. This led to the emergence of a heterogeneous system landscape made up of many individual software solutions, which is the status quo across the industry today. All of these parallel systems had to be meticulously linked together via interfaces. The consequences of such a system landscape include redundancy in processed data as well as increased system operations and maintenance costs. In addition, each of these systems must also be operated and maintained separately.

In recent years, the possibilities for IT support have increased significantly, both with regard to the amount of data processed and the functional complexity. Over the course of the last 40 years, IVU Traffic Technologies AG has acquired a wealth of expertise in the field of scheduling and dispatching software. IVU.rail provides our clients with a standard, commercial off-the-shelf solution that covers the scheduling and dispatching process in its entirety, from service planning and operational implementation in optimized vehicle and duty schedules to the daily dispatch of roll-out materials, locomotive engineers, on-board service personnel and stationary personnel. For the first time, all scheduling and dispatching processes have been consolidated in one system and one database – technically, temporally and physically.

In cooperation with leading railway companies in Europe, Asia and North America, IVU.rail is continually being upgraded and adapted to new technological advances. Sophisticated optimization components have been included over the past few years, which are based on elaborate mathematical algorithms, but which at the same time take into consideration all business rules, union work rules and parameters from manual scheduling in order to obtain results that can be directly used for operations. This means that the processing time for the implementation of a new timetable can be drastically reduced and the resources needed for such a procedure can be cut back.
Many tasks. One product.

Schedule efficiently with IVU.rail

Whether for personnel or vehicle deployment, IVU.rail enables your staff to efficiently manage all conceivable scheduling tasks. The system even incorporates business rules, union work rules and quality guidelines. With its fully automated variation calculations, parameter analyses and intelligent algorithms, IVU.rail paves the way for dependable decision-making. The ability to assign weights to parameters that matter to each individual organization (including parameters that pertain to cost efficiency, operational stability, employee satisfaction and others), guarantees optimized duty and vehicle cycle schedules that meet your specific requirements. In addition, IVU.rail.plan provides an array of interfaces for adjacent systems and allows for the generation of numerous statistics and printouts.

Dispatch quickly and flexibly with IVU.rail

The daily deployment of vehicles and personnel poses a challenge to dispatchers working in long distance, regional, commuter and city transportation roles. Can job scheduling be optimized in such a way that union work rules, legal regulations and economic aspects are taken into consideration? Have any train engineers called in sick? Have the vehicles been deployed in accordance with the service interval guidelines from the maintenance workshop? IVU’s dispatching systems give your dispatchers an overview of which resources are currently in use and where they are located in real-time. Thus, rail dispatchers can quickly react to disruptions in a flexible manner – e.g. they can switch out personnel or deploy replacement vehicles. This flexibility provided by IVU.rail.crew and IVU.rail.vehicle is of utmost importance in ensuring a high service level while not losing sight of the costs involved.
Integrated resource scheduling, dispatching and optimization

**IVU.rail.plan**
Manages the entire service planning process (network design, route design and stop layout, frequency determination, timetabling), vehicle scheduling and duty scheduling – from strategic scheduling to date-specific exceptions. By using intelligent algorithms, IVU.rail.plan optimizes vehicle cycles and jobs while taking into account all operational rules and guidelines.  

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**IVU.rail.crew**
Manages the entire personnel deployment process from job bidding, spare (extra) board and long-term vacation planning to daily dispatching and precise payroll accounting. The dispatcher is provided with optimal support via the automatic personnel allocation and mobile employee portal with duty sign-on/off control functions.  

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**IVU.rail.crew**
Manages and controls the entire vehicle deployment process, including disruption management and monitors the operating performance and service intervals of individual vehicles. Track occupancy can be recorded in detail in stations/yards and parking facilities; shunting/switching processes can be scheduled.  

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OUR CLIENTS – A SELECTION.

Standardization and individuality.

IVU.rail is a proven standard software solution and has been implemented by many operators and rail companies around the world. IVU.rail was developed in close cooperation with leading European, Asian and North American rail operators and is the only standard product that supports complete and integrated resource scheduling, dispatching and optimization. At the same time, this standard product is integrated inside of a developed system landscape and can be adjusted to meet client-specific needs. This is facilitated in the system by the flexible parameterization of rule systems, interfaces and printouts. Project implementation, which in the past might have taken several years, can now often be completed within only a few months.

IVU.rail for VIA Rail Canada

Complete crew management with duty scheduling, optimization and dispatching for over 1,200 train personnel including job management, seniority bidding and scheduling of employees in 5 time zones.

IVU.rail for Trenitalia (Italian Railways)

Vehicle and duty scheduling, optimization and dispatching for over 14,000 employees (locomotive engineers, on-board service personnel and shunters) in passenger and freight transportation across all of Italy. Companywide data integration for long-distance and regional transport, the creation of timetable booklets and the provision of data for booking and reservation systems.
**IVU.rail for the Swiss Federal Railways SBB**
Duty scheduling and dispatching for more than 6,500 locomotive engineers and on-board service personnel using a further developed version of IVU.rail.crew. Over 200 users at SBB work at 21 different locations throughout Switzerland and must be able to access all of the data simultaneously in three different languages. Since 2014, the Freight division of SBB has been using IVU.rail to schedule and dispatch 350 locomotives, 2,530 employees and 7,000 freight wagons.

**IVU.rail for Deutsche Bahn AG (German Railways)**
Vehicle and duty scheduling, optimization and dispatching for over 2,800 employees and 1,300 trains for the suburban rail systems in Munich, Berlin, Hamburg, Rhine-Main (Frankfurt), Rhine-Neckar as well as over 20 regional bus companies (15,000 buses) of DB Regio AG in Germany.

**IVU.rail for Transdev Germany**
Integrated scheduling and dispatching of vehicles and employees in one central system for all of Transdev Germany’s bus and rail services with IVU.rail.plan, IVU.rail.crew, IVU.rail.vehicle and IVU.suite. Transdev Germany operates 332 railcars, 24 locomotives, 20 trams, 1410 buses and has 5352 employees.

**IVU.suite for BVG (Berlin)**
Integrated scheduling and dispatching of vehicles and employees for the largest city transit operator in Germany with over 1,300 busses, 360 streetcars, 1,200 metros and nearly 13,000 employees.
OPTIMIZING DEPLOYMENT OF LIMITED RESOURCES.

A stable timetable that meets demand and requires as few personnel and vehicles as possible – this is a challenge for rail operators everywhere. Optimization of resource deployment offers the greatest potential for improving efficiency.

The scheduler faces the difficult task of taking into consideration client requests, vehicle equipment, labor-law provisions, special incidents (such as construction, sporting events, and many others) – and all of this on a real-time basis. At the same time, however, the scheduler must provide for operations that are as economically viable as possible. Since the creation and evaluation of timetable scheduling, vehicle scheduling and duty scheduling scenarios based on specified criteria is fundamental for optimal scheduling, this task is hardly conceivable without technical support.

Depending on capacity demands, train formations must be assembled and split apart. When doing so, the entire scheduling process occurs in an integrated manner, taking into consideration:
- Existing company guidelines
- Special equipment
- Available personnel qualifications
- Legal and labor-law-related provisions
- Passenger counts
- Service and maintenance schedules
- Workshop capacities
- Predefined rule checks

“IVU.rail has already been used for many years by DB Regio for the integrated and resource-spanning project scheduling and dispatching of select suburban rail transport operations. The highly integrated processing and the corresponding optimization parameters allow for an immediate reaction to short-term timetable changes that, for example, are caused by the additional ordering of special services and unscheduled construction throughout the year.”

Dr. Frank Scholz
CIO
DB Regio AG
IVU.rail.plan manages the entire service planning process (network design, route design and stop layout, frequency determination, timetabling), vehicle scheduling and duty scheduling – from strategic scheduling to date-specific exceptions. The system plans and integrates track occupancies/yard management, parking action and maintenance scheduling.

Timetable planning

- From development of the long-term annual timetable to short-term changes
- Data transfer from track scheduling systems in standard railML format (www.railml.org)
- Compilation and revision of timetables

Train trips and vehicle cycle schedules

- Combine trains and connect them to vehicle block series
- Automatic calculation of the position and orientation of a vehicle in the train formation (train consist)
- Consider vehicle types, service intervals, workshop capacities, passenger counts and layover times in vehicle circulation scheduling optimization

Duty schedules to support crew planning

- Duty suggestion system and duty optimization
- User-defineable fare and work-time regulations
- Full integration with vehicle cycle schedule planning
IVU.rail.crew

THE RIGHT EMPLOYEE.
THE RIGHT PLACE.
THE RIGHT TIME.

Which engineer is driving which train today? Different vehicles, equipment and track segments require appropriate qualifications. In addition, rest time regulations, operational provisions, and vacation/day-off/temporary vacancy requests must be taken into account in duty scheduling where rules and procedures allow. Optimized and rule compliant schedules and jobs are produced that can be bid upon by the workforce. Seniority can be considered throughout the whole process e.g. for job awarding. In either operational environment, vehicle and personnel dispatching should be integrated in order to achieve the optimal deployment of resources.

Clear displays provide an up-to-date picture of the duties for which an employee is actually signed on. The dispatcher must check the duty sign-ons, the extra/spare board and find replacements as quickly as possible for cancellations due to sickness or delays and prepare all of the data for payroll accounting. Aside from manually entering this data, the registered times can also be validated via card readers, stationary or mobile devices or train position data. These tasks would be far less efficient without software support.

By entering their individual preferences, the operating personnel also take part in crew scheduling where labor rules allow. Requests can be entered via terminals, mobile devices or the Internet. Or, where employees are required to bid on jobs, employees may view jobs and place bid preferences. These preferences may be used to assign the jobs automatically with respect to seniority of the employees. Duty allocation to staff through IVU’s optimized personnel dispatching module takes employee requests into account and helps balance employee work time accounts while creating fair schedules for staff. Employee absences as a result of vacation or sickness, for example, are also taken into account in the process, along with employee-specific qualifications. Additionally, the extra/spare board and vacation board can be optimized using the same set of tools. In order to guarantee a continuous flow of data, IVU.rail.crew contains standardized interfaces to all leading HR management systems.

Mauro Natali
Production Manager for Regional Transport
TRENITALIA
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IVU.rail.crew

SATISFIED EMPLOYEES.

IVU.rail.crew manages the entire personnel deployment process, from long-term vacation scheduling to daily dispatching and precise payroll accounting. The dispatcher is provided with optimal support with the optimized personnel dispatching and mobile duty sign-on control functions, while the staff is involved by entering their individual preferences.

Building efficient duties that conform to the rules

- Duty suggestion system and duty optimization
- User-definable fare and work-time regulations
- Schedule on-board personnel (locomotive engineers, on-board service personnel)
- Integrated multiple crewing with user-definable rule system

Long-term preliminary scheduling

- Job and roster scheduling as well as long-term vacation scheduling
- Weekly template optimization for a cyclical, even distribution of employee activities
- Scheduling on the basis of shift classes and concrete duties

Allocation of employees and accounting

- Employee participation via job requests, vacation requests and call-list preferences
- Optimized personnel dispatching on the basis of qualifications, Union-agreement rules, work time objectives etc.
- Online communication with operating personnel via mobile devices
- Automatic award process for bidding considering seniority, qualifications and employee preferences
- Integration of actual trip data
- Employees submit actual times (through mobile devices)
- Subsequent approval workflow
- Transfer actual data to payroll accounting
- Mobile employee portal
MANAGEABLE COMPLEXITY

IVU makes integrated resource scheduling easy.
DISPATCHING ROLLING STOCK.

Once the timetable and vehicle cycle schedule have been created, dispatchers are faced with the challenge of organizing vehicle deployment as efficiently as possible. Vehicle management is particularly complicated in rail transport. Train formations may be split and continued as separate services, or vehicle groups may be removed or added. Such reconfigurations are all part of the everyday work of dispatchers.

IVU.rail.vehicle supports the dispatcher in the entire vehicle deployment and disruption management process. The operational performance and service intervals of the individual vehicles are monitored continuously and shared with the maintenance workshop systems via online interfaces. The detailed depiction of the parking facilities helps with the scheduling of shunting procedures.

During operation, the dispatcher must react quickly and effectively to disruptions such as delays and cancelations. IVU.rail.vehicle supports this with its ‘scheduled’ and ‘actual’ displays and the calculation of arrival prognoses, including their effects on layover times and subsequent trips.

When managing operations and disruptions, the dispatcher must be careful to consider vehicle equipment and conditions, integrate special transport services, schedule maintenance actions, relay and assign open parking spaces and take into account personnel allocations. Therefore, modern dispatching systems should provide an overview of which vehicle is currently deployed and with which crew. This is exactly what IVU.rail does.

“Using IVU.rail, it was possible to centralize the scheduling of our personnel and vehicle deployment for all of Hungary. The integration of actual data from our vehicle tracking system helps our dispatchers to react quickly to deviations from schedule and disruptions and reduce the effects on subsequent trips.”

Ferenc Márton
Chief Operations Officer
MÁV Hungarian State Railways
IVU.rail.vehicle schedules and controls the entire vehicle deployment process, from long-term maintenance scheduling to the real-time train schedule situation. IVU.rail.vehicle monitors the operating performance and service intervals of individual vehicles. Track occupancies can be recorded in detail at stations, yards and parking facilities. Shunting procedures can also be scheduled.

**Optimizing vehicle cycle scheduling**

- Schedule locomotives, multiple units, passenger cars and wagons
- Incorporate company-specific operating rules like roster rules, maintenance rules, passenger amounts and capacities

**Taking maintenance and operations into consideration**

- Pre-schedule the maintenance window for optimal utilization of vehicles and maintenance workshops
- Monitor operating performance and service intervals
- Dispatch parking facilities and maintenance workshop transfers

**Reacting to disruptions**

- Display vehicle positions in real-time, analyzing the effects on subsequent trips
- Manage all delays and cancelations in a fast and agile way
- Monitor pull-out and pull-in trips and parking locations of vehicles
- Find and allocate replacement vehicles, integrate short-term transfer trips

**Shunting (switching) and parking**

- Track-specific shunting and parking in the train station, in yards or parking facility
- Consider track and yard capacities (restrictions)
- Service block scheduling (refueling, cleaning, maintenance)
- Pre-schedule maintenance capacities and workshop workloads
There have been significant improvements made in the field of rail transport. ZIB and IVU have combined mathematical research with engineering expertise and practical experience in order to tap this potential.

Prof Martin Grötschel
Vice President of Konrad-Zuse-Zentrum for Information Technologies in Berlin (ZIB)
Efficiency is increased with the optimization tools from IVU.rail by combining mathematical research with engineering know-how and hands-on experience.

Duty schedule optimization

- Consider union and fare agreements, as well as operational guidelines
- Guarantee complete scheduling of all duty elements
- Incorporate qualification and capacity guidelines
- Consider multiple crewing /teams

Vehicle cycle optimization

- Consider service intervals, maintenance cycles, workshop capacities, infrastructure capacities and passenger counts
- Ensure uniform distribution of performance over a longer period of time
- Create robust vehicle schedules while simultaneously minimizing required vehicles and non-revenue trip distances

Weekly run-schedule optimization

- Reduce variations during the week with fewer overtime hours
- Better distribution of days off and undesirable duties (e.g. late duties or split duties)
- Acceleration of the entire scheduling process

Optimized personnel dispatching

- Observe qualifications, capacities and rule systems
- Achieve highest possible productivity
- Maintain work time directives
- Keep employee accounts balanced and allocate them fairly
- Consider individual employee requests
Our IVU.suite provides all task areas of a transportation operator with appropriate support and allows for integrated solutions with a single product: from scheduling and dispatching via operation management (CAD/AVL), to ticketing and real-time passenger information, as well as settling transportation contracts.

IVU systems schedule routes, deploy vehicles, provide passengers with information, ensure transfer connections, dispatch employees, monitor fleets, sell tickets, combine data and increase efficiency. Whether you are looking for a complete solution or individual components – our products are based on open standards and can be integrated easily into a wide range of system environments.

Over 400 employees develop software, advise clients, work on new concepts, implement systems and optimize workflows in countless projects from 15 locations in thirteen countries. Our strength is based on the performance, knowledge, motivation and personalities of the people who work at IVU and engineer IT solutions made in Germany.

“The products of the IVU.suite have enabled us to develop a modern transport system in Santiago de Cali within the shortest period of time possible. This has had a positive impact on the inhabitants’ quality of life and the cityscape.”

Luis Eduardo Barrera
President of
Metro Cali S.A.
IVU IN USE AROUND THE WORLD.

A growing community of clients ensures the continued development of IVU.rail. They exchange information and share experiences in various user groups. This map shows a selection of railway companies using IVU.rail, further details can be found on -> Page 6 and at www.ivu.com/rail

VIA RAIL CANADA INC.  
Montreal (CA)  
Scheduling, optimization and dispatching of employees across the entire country

VNR VIETNAM RAILWAYS  
Hanoi (VN)  
Scheduling, optimization and operational control of vehicles and employees across the entire country, as well as fleet management and real-time passenger information

TRANSPORT FOR LONDON  
London (GB)  
Current departure times for 8,500 buses at 19,000 stops all over the city on electronic displays, via the Internet or on smartphones
DEPARTMENT OF PLANNING, TRANSPORT AND INFRASTRUCTURE
Adelaide (AU)
Central timetable planning system for buses and trains in the wider Adelaide area

BKK BUDAPEST
Budapest (HU)
Fleet management and real-time passenger information for some 2,200 buses, trams, trolley buses and ferries operating on 220 lines in the Hungarian capital

STOCKHOLMSTÅG
Stockholm (SE)
Integrated resource scheduling for suburban rail operations with 160 trains, and interfaces to the network operator and the maintenance workshop

BANGKOK METRO
Bangkok (TH)
EXPRESS RAIL LINK
Kuala Lumpur (MY)
Scheduling and dispatching for rapid transit train services, including Kuala Lumpur’s airport transfer

JERUSALEM TRANSPORTATION (JTMT)
Jerusalem (IL)
Planning, scheduling, dispatching, fleet management and real-time passenger information for (East)-Jerusalem

REGIONAL TRANSPORT AUTHORITY
Auckland (NZ)
Timetables for all buses, trains and ferries are generated using IVU.plan, the information from the various operators is brought together in IVU.pool

VERKEHRSBETRIEBE ZÜRICH
Zurich (CH)
Personnel dispatching with IVU.crew for 1,300 operators; integration of Swiss holiday points system and individual appointment administration
ALL ADVANTAGES AT A GLANCE.

IVU.rail is a standard product with a modular construction. The modules can be implemented individually, as a whole or in combination with other systems or individual developments. All modules run on a single database, with open interfaces to all common peripheral systems, e.g. from the fields of HR management or maintenance workshop management.
### IVU. RAIL. PLAN

#### Network Setup
- Train stations and operational units
- Links and route courses
- Change of direction points
- Parking facilities
- Any number of network point groups for regional assignments

#### Timetable Planning
- Editing in the graphical and tabular timetables
- Trip course and train formation building
- Sequence scheduling and vehicle orientation
- Footnotes and comments
- Vehicle types and trip numbers

#### Vehicle Cycle Scheduling
- Link trips and transfer trips to vehicle blocks
- Receive suggestions for appropriate following trips
- Consider train formations and changes of direction
- Pre-schedule maintenance windows
- Generate vehicle schedules on the basis of parking actions
- Schedule service blocks (refueling, cleaning, maintenance)
- Vehicle cycles
- Layover, buffer and preparation times

#### Duty Scheduling
- Configure duty rules, break rules and fares
- Duty optimization and adjustment optimization
- Schedule manual duty elements
- Duty scheduling
- Travel path and passage trip search
- Multiple crewing (locomotive engineers, service attendants, service supervisors etc.)
- Stationary personnel (yardmasters, station clerks)
- Coupling performances, cab changeover times, takeovers/handovers
- Generate additional duty pieces on the basis of the number of auxiliaries in the train formation
- Different duty rules are possible per crew type
- Optimization according to various crew types is possible

### IVU. RAIL. CREW

#### Roster Scheduling and Bid Management
- Schematic and/or calendar-related scheduling
- Anonymous long-term preliminary scheduling
- Weekly template scheduling and optimization
- Job creation and optimization
- Roster layout optimization
- Shift class scheduling
- User-definable business rules (e.g. union rules, legal rules, preferential rules etc.)
- Full support of easy to use bid management process
- Employee portal supports strong communication between dispatcher and crew

### Personnel Dispatching and Disruption Management
- Job-bidding
- Optimized personnel dispatching
- Manage requests, shift classes and account
- Report duty sign-on/off from mobile devices as well
- Employee portal supports strong communication between dispatcher and crew
- User-definable dispatch levels (long, medium, short, actual etc.)
- Qualification checks and extensions
- Automatic account update (work time, weekly rest, etc.)

#### Timesheet and Payroll Accounting
- Interface with HR systems (e.g. SAP, Peoplesoft, etc.)
- Consideration of actual train arrival/departure times
- Assess scheduled and actual work times
- User-definable payroll rule system for all personnel timesheets
- User-definable payroll rule system for all wage agreements

### IVU. RAIL. VEHICLE

#### Yard Management
- Schedule track occupancies in train stations, yards and parking facilities
- Consider track and depot capacities (restrictions)
- Consider station duty order
- Schedule coupling procedures
- Supply scheduling

#### Vehicle Monitoring
- Connect to vehicle location systems for actual data (vehicles, times, travel paths)
- Synchronization of scheduled and actual data and delay prognoses
- Monitor pull-out and pull-in trips
- Recognizes and corrects the difference between scheduled and actual parking actions
- Direct control of passenger information
- Prepare dynamic dispatching data via railML