# Rittal – The System.

## Faster – better – everywhere.

**IT white paper – RiZone – Rittal's
management software for IT infrastructures**

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## Table of abbreviations

| | |
|---|---|
| CMC | Computer Multi Control (a data centre's sensor network system) |
| CRAC | Computer Room Air-Conditioning Equipment |
| DCiE | Data Center Infrastructure Efficiency |
| ERP | Enterprise Resource Planning |
| IP | Internet Protocol |
| LCP | Liquid Cooling Package |
| MIB | Management Information Base |
| PSM | Power System Module -- a modular, pluggable socket system (Power System Module) |
| PUE | Power Usage Effectiveness |
| RFID | Radio Frequency Identification |
| SNMP | Simple Network Management Protocol |
| SQL | Structured Query Language |
| UPS | Uninterruptible Power Supply |
| WPF | Windows Presentation Foundation |

## Executive summary

RiZone is Rittal's IT infrastructure management software for data centres. RiZone is the ideal tool to help IT administrators master their day-to-day challenges – everything from monitoring and management of single devices and components to the optimization of the entire data centre with regard to cost-effectiveness, availability, reliability and security.

RiZone monitors and manages all the IT infrastructure components required to ensure the secure and reliable operation of the servers, storage systems, routers and switches. These include:
- Power supply and backup
- Cooling and air conditioning
- Room and enclosure monitoring
- Data centre safety and security (physical access control, temperature, etc.)
- Efficiency and energy consumption



*Figure 1: RiZone*

IT administrators need to be aware of the interdependencies between the various systems and facility functions of a data center, such as physical IT infrastructure, networks, servers, central building control systems and ERP software. RiZone offers intelligent interfaces that help to build a complete and up-to-date picture of data-center resources.

RiZone can analyse trends and visualise the data centre's overall consumption data (kW/h, euros, $CO_2$ emissions) and efficiency level. The software allows users to define control loops for maintaining the ideal operating point in line with changing conditions. This enables the IT infrastructure to be continuously optimised to drive costs down and keep them as low as possible.

RiZone's standard SNMP interface and MIB enables the software to be integrated with higher-level server or network managing systems.

Integrated capacity management features, in conjunction with the RFID-based Dynamic Rack Control (DRC) system, enables the automatic generation of overviews showing the unused physical resources and capacity (height units, weight, electric power) in each enclosure.

## Introduction

Energy efficiency, sustainability and green IT are some of the buzzwords used to describe the new challenges that IT administrators are faced with. Energy consumption has become one of the biggest cost factors in day-to-day operations, and so must be strictly controlled. At the same time, cost-cutting must not come at the expense of the data centre's ability to serve its purpose effectively. A data centre is required to provision IT services to end users rapidly and to guarantee sufficient performance. Today's most modern data centres are characterized by high availability and resilience.

Against this background, IT infrastructure management software needs to meet the many and varied needs of IT administrators. It must be able to monitor all infrastructure components and to take corrective action, where necessary. A network of distributed sensors enables all relevant parameters and alarms to be captured, documented, and visualized in an easy-to-understand way.

Ideally, software of this kind offers IT administrators a complete picture of the data centre as a single entity. Similarly, it is useful if the same software tools are employed to monitor both the infrastructure and the applications running on the servers.

RiZone, Rittal's IT infrastructure management software, is designed to meet administrators' needs across the board. Because the software is modular and scalable, it is equally suitable for SMEs and for major corporations such as large banks, for which extremely high availability and resilience are mission-critical.

Furthermore, RiZone communicates with higher level IT management systems – which in turn supports a holistic approach to the optimization of entire data centres (services and components).

## Requirements for IT infrastructure management software

The following sections will first describe the requirements that management software for IT infrastructure must fulfil. The component view focuses on all the hardware and infrastructures needed to run the active systems (such as servers, storage systems, switches and routers).

### The component view

#### Power supply and distribution

Depending on the level of availability and resilience required, power is supplied via one or more independent feeds. At the low-voltage main distribution boards, the power output is measured in the infeed and the outgoing sections to obtain the total power requirements of the data centre, its facility functions and subsystems (e.g. cooling). The low-voltage distribution board also distributes power to the various systems and functions of the IT infrastructure.



*Figure 2: Power distribution and backup*

Uninterruptible power supply (UPS) units ensure the continued availability of power in the event of outages. A UPS separates the primary grid (the power lines from the utility) from the power supply to the equipment in the data centre. The latest UPS systems achieve this by converting the primary alternating current to direct current before converting this back to 'clean' AC free of spikes and noise

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with which to supply the equipment. The DC circuit has a battery for backup, should the primary feed fail. On the consumption side, the feed is subdivided until ultimately reaching the socket of an installed device (e.g. a server). Intelligent power distribution systems, such as Rittal's PSM, allow equipment to be individually powered up or down, and support consumption metering.

One of the key tasks of IT infrastructure management software is to monitor the entire power distribution chain (including backup) from the low-voltage main distribution board to the hardware components, and to capture all relevant parameters.

**Cooling and air-conditioning systems**
Almost all the electric power fed into the data centre is ultimately converted to heat by the IT hardware. This heat must be dissipated from the data centre, which is accomplished by generating and distributing sufficient cooling.

Cooling can be produced in various ways. The most effective method and the most suitable combination of technologies are selected in accordance with the customer's requirements. Chillers, like refrigerators, generate cooling by means of electric power, which makes them major energy guzzlers. In many cases, however, free cooling with outside air can drive down the temperature of warm water sufficiently to meet a data centre's cooling needs. Chillers and free-air cooling systems can complement each other very effectively, assuming appropriate control systems are in place.



*Figure 3: Generating and distributing cooling*

A pipe system feeds the cooled water into the data centre. If the facility has a raised floor, the cold water is generally routed to the CRAC units' heat exchangers. The warm air in the server room is drawn into the CRAC units, which cool it in their heat exchangers, and discharge the cooled air under the raised floor. The cold air emerges in front of the server enclosures through perforated floor tiles, where it is drawn in by the computer hardware.

It makes very good sense to strictly separate a data centre's cold and hot air streams. This is done by containing the aisles between rows of enclosures by fitting ceilings, and doors at either end. In addition, sensors installed in the hot and cold aisles enable the temperature to be monitored and precisely controlled.

To cool high-performance servers, chilled water can be routed directly to the enclosure rows. Rittal's Liquid Cooling Package (LCP) is a heat exchanger that can be mounted on the side of an enclosure. This enables cool air to be discharged directly in front of the 19-inch racks, where the server fans draw it in. The hot air expelled from the servers is returned to the heat exchanger. This efficient solution creates a closed air circuit in the enclosure. It is critical to ensure that any openings are sealed with blanking panels to prevent cold and hot air from mixing.

IT infrastructure management software must be able to monitor and effectively manage a data centre's entire cooling and air-flow system.

**Safety and security components**

An equally important task for IT infrastructure management software is to gather and evaluate all safety- and security-related data obtained from sensors, and where necessary, to respond appropriately (e.g. by generating an alarm).

Preventing the misuse of data is a key concern for all organisations. The CMC system controls access to the server racks and logs access requests by identified persons (authentication by smart card, transponder or magnetic card) and attempted access by unauthorized persons (vandalism sensor). The CMC also uses sensors to capture all safety-related parameters such as temperature, humidity, smoke, air flows and leakages. And it records all IT equipment power consumption data.



*Figure 4: Safety and security components*

The CMC system also enables the IT infrastructure management software to take corrective action on the equipment being monitored – for example, to regulate fan speeds or pumping rates.

**Enclosure components**

Many of the sensor types mentioned above are also found inside the network and server enclosures. Furthermore, the enclosures themselves can be equipped with smart functionality to help manage the installed IT hardware. This is done by installing an RFID antenna in the 19-inch mounting frame. This antenna can read the data on a component's RFID tag. The device data, written to the tag when the equipment is inventoried, includes details such as the serial number, MAC address, power input, size in height units. Whenever equipment is installed or modified, this is registered via the enclosure's RFID antenna and forwarded to the IT management software, enabling the dynamic management of data-centre assets.

**Building services components**

IT management software must register other kinds of components, including building services equipment, physical access control, server room fire extinguishing and CCTV systems.

## The application view

### Network components
The active components relevant to network management are the switches and routers. A switch links multiple segments in a LAN, analyses incoming data packets and forwards them to the appropriate segment if it recognises the destination MAC addresses. Routers, by contrast, do not function on layer 2 of the OSI model, but on layer 3. They analyse the entire destination address before forwarding data packets.

The leading switch and router manufacturers also provide management software for network components, which is used to configure and monitor LANs.

### Server and storage components/services
The applications and services of relevance to end users run on the data centre's servers, and these communicate with appropriately configured storage systems. Experience has shown that software lifecycles are longer than those of hardware systems. In other words, the market continues to offer faster and more powerful processor and server technologies while legacy programs have to remain in use. This has made it necessary to decouple the physical computer hardware from the programs that run on it by means of virtualisation. Virtualisation software simulates the operating system version and computer hardware that each program needs. As a result, a variety of software products with different requirements can run on the same server hardware.

The hardware manufacturers offer software for managing both virtualised resources and client/server infrastructures.

## The view of cost drivers and potential efficiency gains
IT administrators are faced with the never-ending task of optimising data-centre operations in terms of cost and environmental sustainability. The PUE (Power Usage Effectivness) metric defined by the Green Grid offers a useful gauge (see Reference 1).

### PUE – Power Usage Effectiveness
PUE is defined as follows:

$$PUE = \frac{Total\ facility\ energy}{IT\ equipment\ energy}$$

where IT equipment stands for servers, storage systems and switches.

DCiE (Data Centre Infrastructure Efficiency) is the inverse of PUE:

$$DCiE = \frac{1}{PUE} = \frac{IT\ equipment\ energy}{Total\ facility\ energy}$$

DciE expresses the relationship between the power consumed to provide IT services and the total power consumed by the data centre. The following applies to both metrics:

They are merely percentages, not absolute figures. For that reason, a data centre's actual consumption data (kWH, euros, $CO_2$ emissions) must also be taken into consideration.

To ensure sustainability, the development of PUE and DciE over time should be examined by means of trend analysis.

The most important issue to consider is how a data centre's energy footprint (and therefore its cost structure) can be improved. The first item on the agenda is consolidation.

**Consolidation**

Consolidation can be achieved with the help of virtualisation technology. Older server models are replaced by the latest high-performance servers (up to and including blade systems). Virtualisation software is installed on the new servers, enabling multiple programmes with different operating system requirements to run on them. While only a small fraction of the former systems' total capacity was utilised, the new, consolidated systems boast a much higher utilisation rate. Consolidation is clearly an effective way to drive down costs by reducing the number of servers employed (and the amount of power they consume). In addition, each server is used more efficiently than before.

If, as a result of consolidation, the servers' power consumption decreases, the data centre's total power consumption will also be lower, since less energy is used by the servers, and the cooling systems' output can be reduced accordingly. It is essential to determine the ideal operating point, so that no more cooling is provided than is actually required.

**Smart climate control strategies**

As mentioned earlier, electrical cooling equipment is a major cost factor for data centres. Permanent savings can be achieved through the use of smart, adaptive climate control strategies.

If the cost of cooling can be reduced for a given server load, this can significantly improve PUE and DciE. This can be achieved by using natural sources of cooling (e.g. direct free cooling, geothermal cooling, groundwater). To exploit free cooling (i.e. the use of outside air for cooling) for a greater part of the year, the temperature of the servers' intake air must be kept as high as possible.

Aisle containment and sealing the space between and alongside the servers are efficient ways of preventing hot and cold air from mixing. A uniform temperature profile, with a difference of no more than +/- 1K, forms in the cold aisles. This permits the inlet temperature of the CRAC units' water circuit to be increased. As a result, free cooling can be used for a greater part of the year.

A further imperative is to size the cooling systems according to actual need. The system (water inlet and outlet) has a high inertia, and in order to manage it efficiently, it is necessary to measure the temperatures inside the enclosures (both in front of and behind the servers). By regulating the generation and distribution of cooling strictly according to need, smart IT management software can deliver additional savings.

**Improving the overall energy footprint**

The IT management software keeps track of the IT infrastructure, the servers, and all relevant consumption data. Server management tools monitor the servers, their loads and the services running on them. Thanks to virtualisation, services can be allocated and scheduled with a view to minimising operating costs. For example:

- Some services can predominantly run at night
- Weekend operations can focus on selected enclosures, while the rest of the IT infrastructure is run at lower load
- Services can be moved to enclosures (or even data centres) whose cooling systems can exploit cost-effective free cooling longer

These methods enable data-centre operations to be optimised in terms of environmental sustainability and operating costs.

## RiZone – Features and functions

### Overview
As high availability is a top priority for any data centre, all environmental variables need to be monitored constantly. The task of IT administrators is to deliver the availability specified in service level agreements with end-customers.

A data centre's availability is not usually affected unless multiple faults and problems occur simultaneously.

When warnings or error messages are issued from multiple IT infrastructure devices in the data centre, they must be placed in a correct logical context. Without knowledge of that context or the direct impact on data-centre operations, error messages and warnings are of very little value.

RiZone combines all messages and sensor data to form coherent and informative sequence of alarms. It monitors and controls:
- Power supply, including backup
- Generation and distribution of cooling
- Server rooms and enclosures
- Data-centre safety and security (physical access, temperature, etc.)
- Efficiency and energy consumption

RiZone efficiently supports all Rittal products deployed in data centres. It also supports
- Asset discovery and management
- Resource modularity and scalability through a flexible licencing model
- Compliance with high availability requirements

In addition, RiZone can be integrated with other management systems.



*Figure 5: Scalability – pay-as-you-grow*

## RiZone's architecture
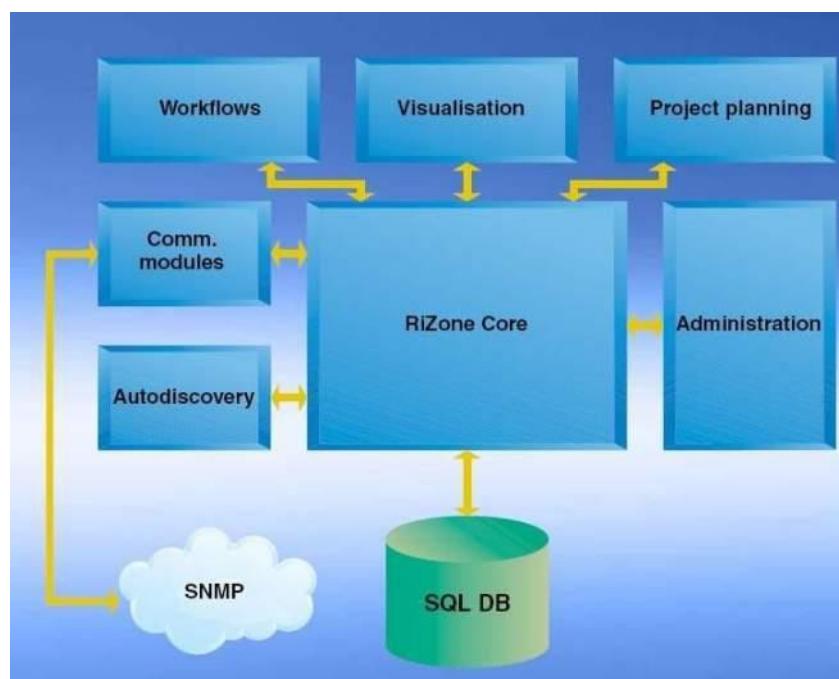The diagram below outlines RiZone's basic architecture.



*Figure 6: RiZone's architecture*

RiZone comprises the following modules:

- **Autodiscovery:** Autodiscovery means the automatic identification of all active RiMatriX5 products and capture of the parameters they supply (third-party products can be inventorised and incorporated manually)
- **Communication:** this module provides means to communicate with other systems via interface drivers
- **Workflows:** this module allows users to define rules used to calculate graphs, generate reports or manage a data centre on a day-to-day basis.
- **Visualisation:** the visualisation module processes all user queries and generates charts and diagrams (e.g. trend analysis).
- **Set-up:** this module places the devices identified by the Autodiscovery module in the correct locations in the schematic diagrams of the IT infrastructure.
- **Administration:** this is where the administrator performs configuration, defines user and group rights, and enters licencing data.
- **Core & Database:** A high-availability core for the rapid analysis and processing of all information, queries and instructions, and for storing configuration settings and historical data in a high-performance SQL database.

The following sections describe the individual modules and their features in greater detail.

## RiZone – Autodiscovery module
The Autodiscovery module is employed to automatically detect and identify all active Rittal RimatriX5 components in the network (sensors, processing units, PSM, etc.). To do this, the software searches through the defined IP address range and attempts to establish contact with the components. The components' identification details inform RiZone what devices are connected to the network and what device data each of them provides.

The devices identified are displayed in a tree structure, after which the Set-up module can then place them in their correct locations in the schematic diagrams representing the data centre.
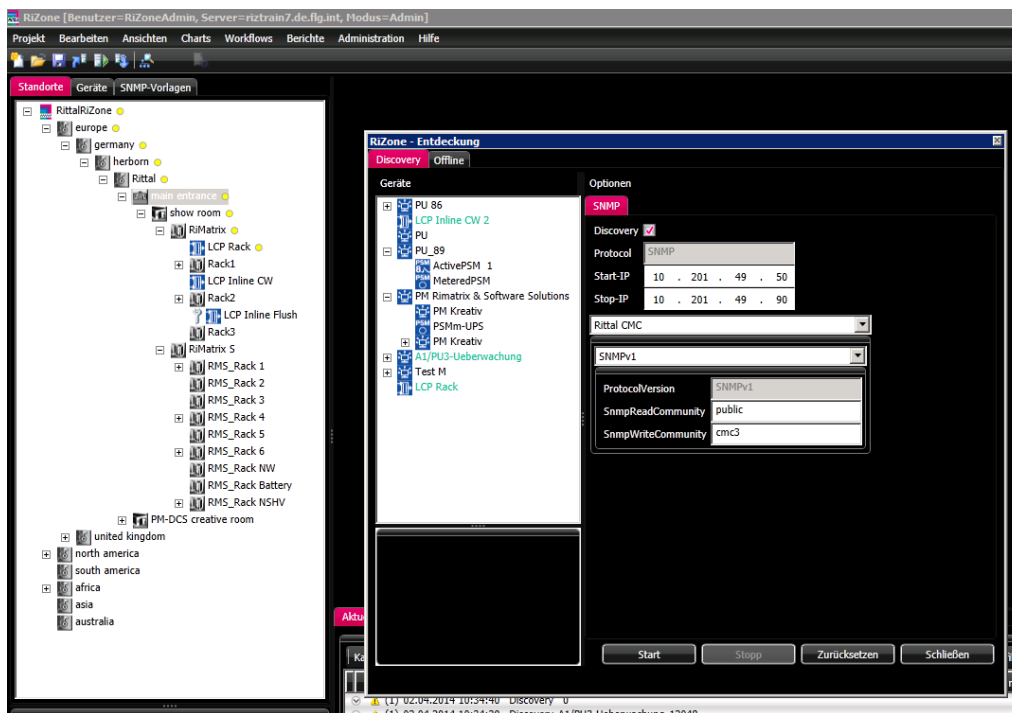
*Figure 7: Autodiscovery of RimatriX5 components*

RiZone also supports the inclusion of non-Rittal equipment (UPS, cooling systems, etc.) provided that these have an SNMP interface, and the MIB documentation is available.
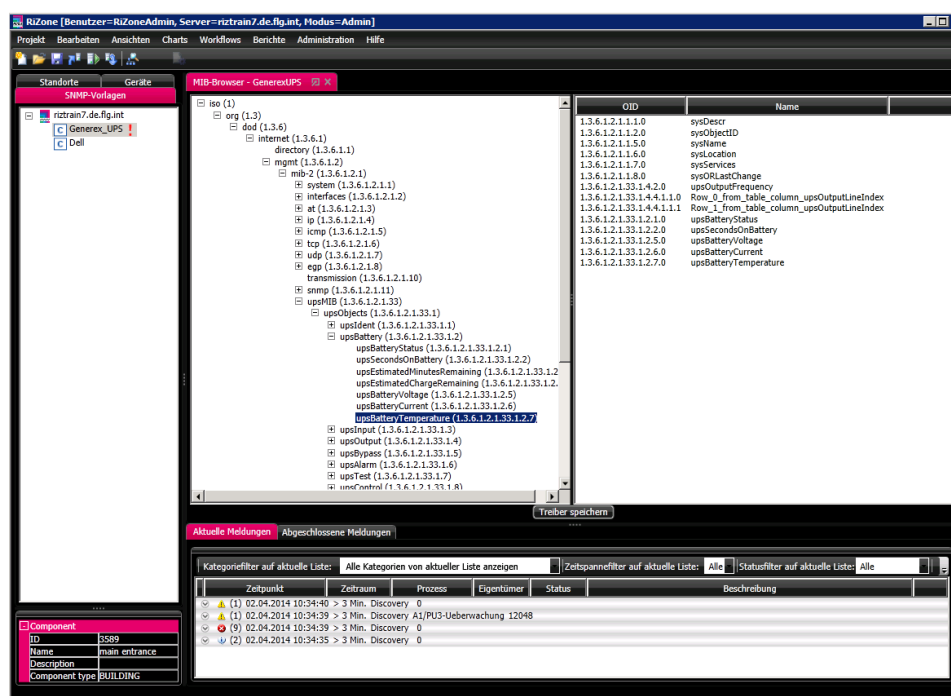


*Figure 8: MIB Browser*

The information required to monitor and control third-party devices is stored in the MIB (Management Information Base) in the form of managed objects. The MIB itself does not contain data; it merely describes how the data can be accessed using an SNMP query.

An MIB is a human-readable file that complies with a predefined syntax. Its contents cannot be understood without the associated documentation, which explains what each entry means.

To manage an SNMP-enabled device, the RiZone Communication module requires a driver that can read from the MIB, access the data described there (via an SNMP-Get) and pass it on as required. However, programming drivers by hand (especially for third-party devices) is time-consuming. Furthermore, every time a third-party MIB is modified, the corresponding driver must be updated accordingly.

RiZone's MIB Browser offers a convenient way of incorporating third-party equipment. The MIB Browser displays the hierarchical structure of the device's MIB (see Figure 4). By referring to the corresponding documentation, administrators can select the variables they would like to monitor and/or control. RiZone then generates a customer-specific driver which enables the device to be integrated quickly and easily.

## RiZone – Communication module

The RiZone Communication module provides the interfaces needed to communicate with other systems. One of the standard interfaces it offers is SNMP.

Third-party equipment can be conveniently integrated via a user-friendly MIB Browser. This allows users to choose the variables they wish to import from a third-party device's MIB. The MIB Browser then generates a local, customer-specific driver.

## RiZone – Workflows module

At the heart of this module is a calculation engine that performs mathematical and logical operations on customer-specific variables. The results of its calculations and operations can subsequently be used in RiZone's reports and charts. At the same time, they form the basis for the control cycles and sequence of alarms.
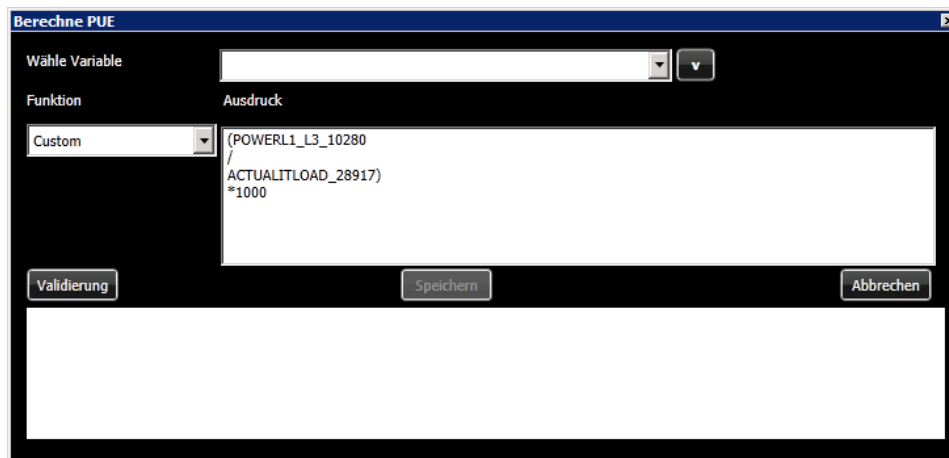


*Figure 9: The calculation engine*

The Workflows module supports user-defined control loops. Simple control loops can be defined by linking various events, triggering a corresponding alarm, and issuing reports according to predefined sequence of alarms (text message, email, emergency calls, fire service, etc.)

More complex control loops can also be defined in RiZone. To keep a data centre's operating costs down, for example, it makes sense to exploit free cooling for as much of the year as possible. The key variables in this context are the servers' inlet and exhaust air temperatures. A suitable inlet temperature ensures that the server is operated within safe temperature limits. The exhaust air temperature reflects the server's load behaviour. These two variables can be used to supply exactly the right amount of cooling.
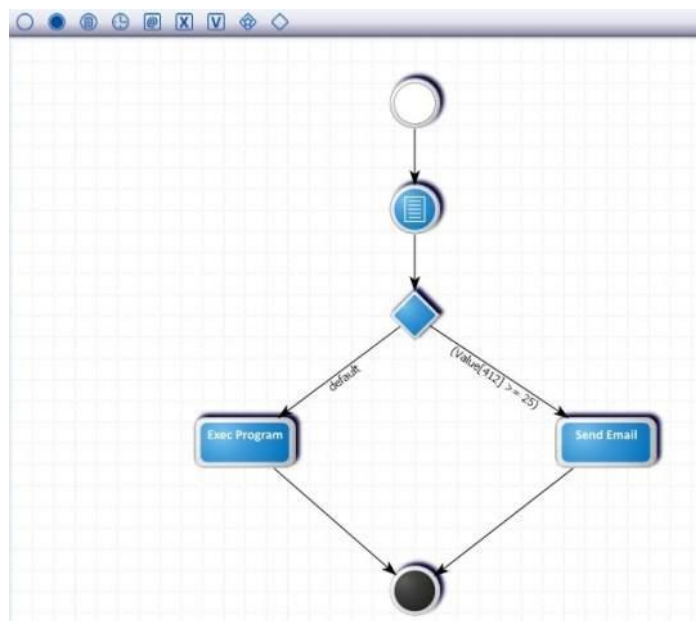
*Figure 10: Workflows*

## RiZone – Visualisation module

This module enables historical data to be viewed in a variety of useful ways. Administrators can individually compile the set of charts they wish to use (number of charts, colours, time periods, etc.). In a nutshell, RiZone offers custom views of the data managed.

Trend graphs enable administrators to identify both critical events and potential for improvements.



*Figure 11: Trend analysis*

RiZone's Visualisation module employs the Windows Presentation Format (WPF), part of Microsoft's .NET framework.

## RiZone – Set-up module

In the Set-up module, the sensors and components identified by the Autodiscovery module are placed in the appropriate devices or enclosures in the schematic diagrams of the data centre. The module

supports a hierarchical representation of an organisation's IT assets. For example, it can visualise multiple distributed data centres, or facilities that comprise multiple buildings or rooms.

Set-up involves determining the logical relationships between the sensors/actuators and the devices monitored and controlled by RiZone.
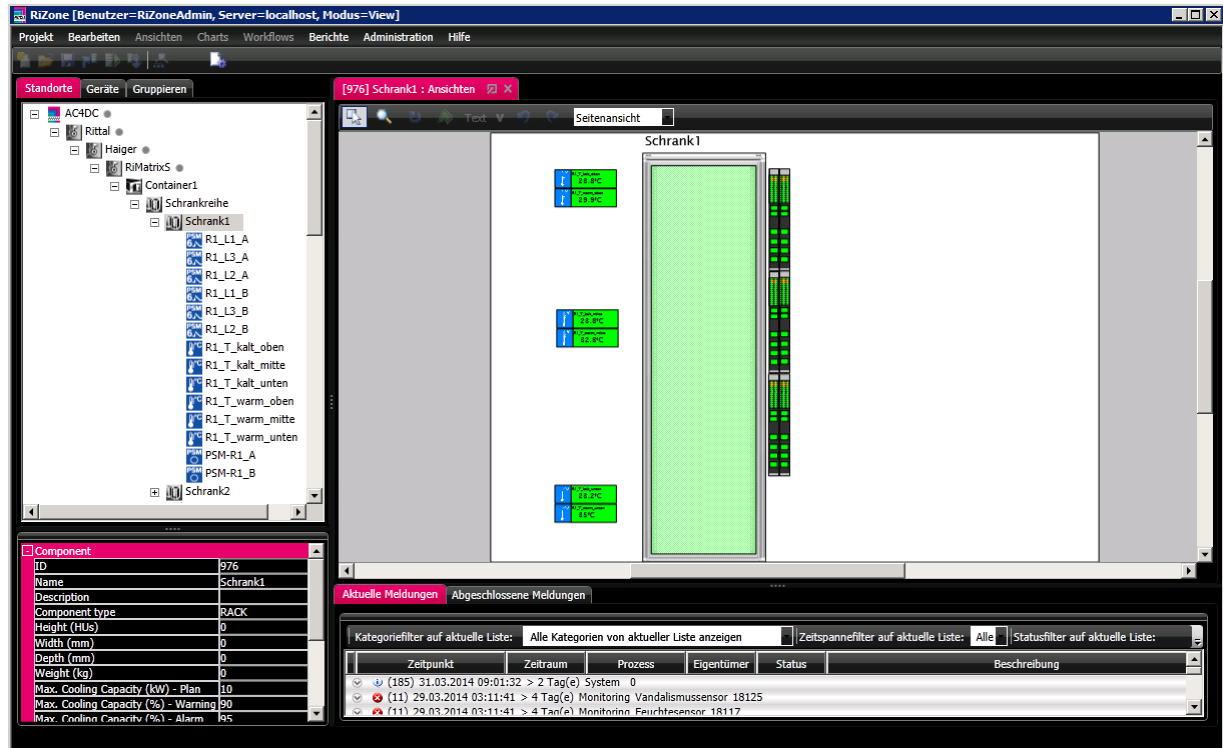


*Figure 12: Assigning six sensors and six PDUs to an enclosure*

For example: RiZone has identified several temperature sensors. However, without knowing in what enclosures and in what position these sensors are installed (cool inlet air or warm exhaust air), their readings cannot be interpreted.

### RiZone – Administration Module
The administration module is used to define user rights, enter licenses and perform configuration.

RiZone supports the definition of multiple user groups that are assigned specific sets of rights. For example, an IT system administrator may have comprehensive rights, while a caretaker or porter may only receive alarm notifications.

In a hierarchical organisational structure, these rights can be associated with individual objects (data centres, buildings, systems, rooms, rows of enclosures, components) in line with defined user roles and rights.
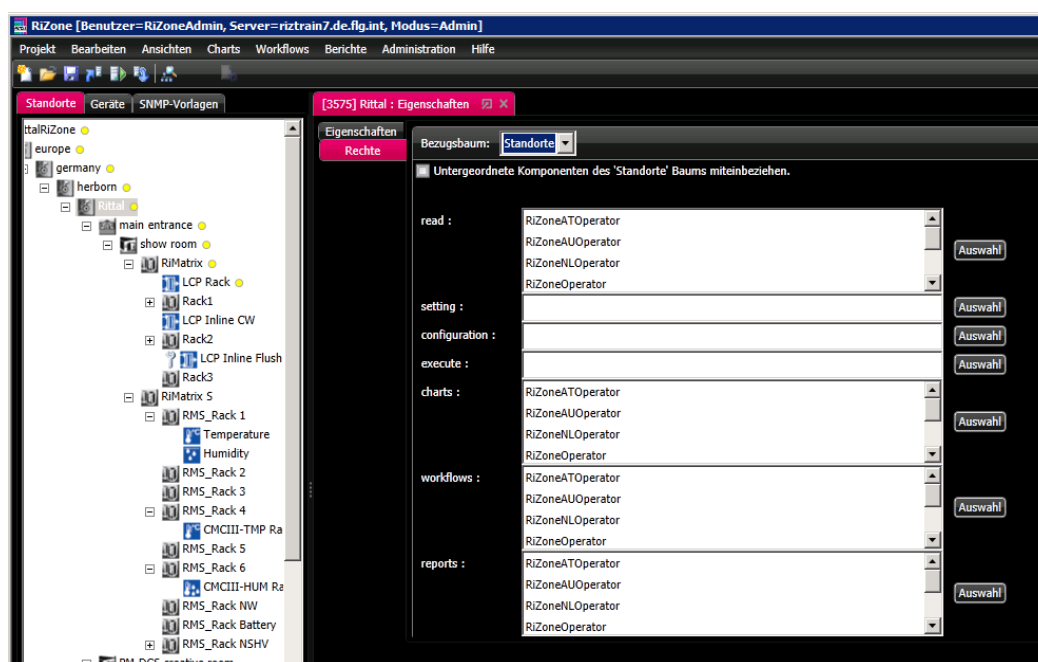
*Figure 13: Object-based management of user rights*

RiZone supports a flexible licencing model that allows the software's scope to be tailored to the needs of individual customers. Licencing is initially performed on the basis of the number of IP nodes (i.e. IP addresses) that will be observed.

## RiZone – Core & Database module

The RiZone Core performs central processing of all events and queries. Events are generally triggered when a parameter value of a sensor or device changes. They are reported to RiZone via an SNMP trap. The Core analyses and evaluates events to decide what response is required.

For example, if a temperature reading changes, but the temperature is still within defined limits, the reading is merely stored in the database. But if the reading exceeds a defined threshold, an alarm is issued by the CMC which must be handled in accordance with the predefined response.

By contrast, queries for the Core to process are generally sent by end users in order to obtain specific information, present data in the desired format, or modify the parameters of IT components.

Events and queries are assigned a priority to allow the Core's Scheduler to manage their processing.

All measurements are stored in an SQL database, allowing them to be used for later analysis and comparisons. To meet individual customers' needs, it is also possible to integrate commercial database systems (Oracle, Microsoft), because a standard SQL instruction set is used at the interface to the RiZone Core.

## Capacity management with RiZone

RiZone's capacity management functionality provides an accurate overview of the devices installed in the enclosures. The devices are entered as components of the enclosure along with information relevant to capacity management, such as the device's height unit, weight, power and cooling requirements, etc.

Thresholds for all capacity management parameters can be defined for each enclosure. If these thresholds are exceeded, an alarm is generated. Alarms can be processed and forwarded just like temperature alarms, for example.

*Figure 14: Capacity management thresholds for a rack*

The devices installed in a rack can be registered manually or automatically by means of the DRC (Dynamic Rack Control) RFID system. With this system, each device is fitted with an inexpensive RFID tag which stores all device details. Each rack contains an RFID antenna that can identify device locations with an accuracy of 1/3 U. The data on the tags attached to the hardware is read automatically and forwarded to RiZone. RiZone aggregates the data, calculates the capacity utilisation and generates dynamic views of the enclosures. If desired, these can even include original images of the installed devices.
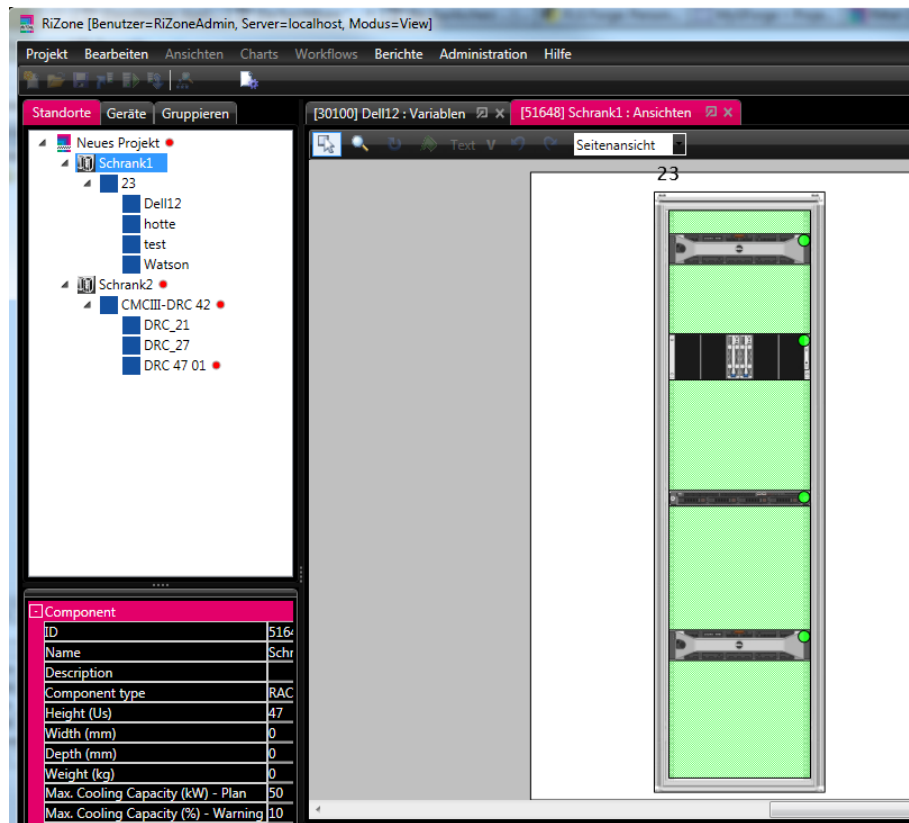
*Figure 15: View generated from capacity management data*

The RFID tags attached to the hardware are also used to monitor whether all devices are still installed in their respective locations in the rack. If a device is removed, an alarm is generated.
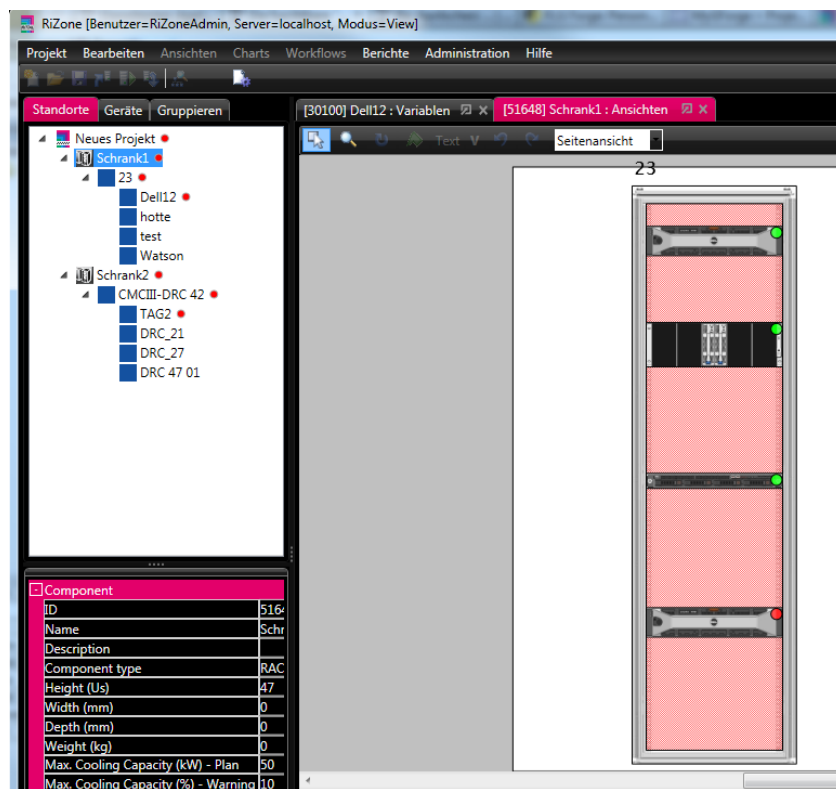


*Figure 16: Alarm triggered by the removal of a device (red dot).*

If the device is re-installed, either in the same enclosure or in another one monitored by RiZone and DRC, the user is informed and the view updated accordingly.
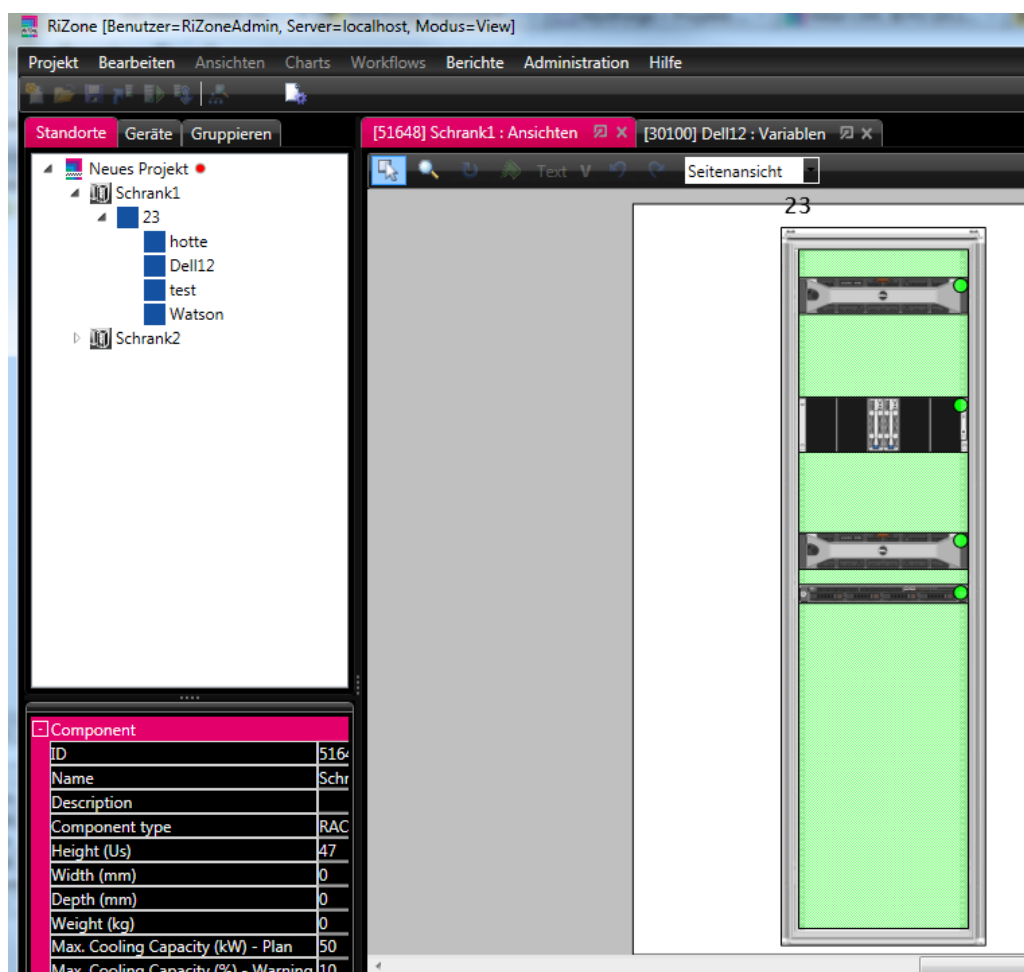


*Figure 17: Rack view after relocation of a server*

Figure 17 shows a view that has been modified following the rolocation of the 2 U server from the bottom to the middle of the rack (cf. Figure 16).

A key feature is the tracking of devices across all the enclosures in the data centre. If a server is moved to another enclosure, RiZone recognises this automatically. The software remains up to date, reflecting the actual location of servers in the data centre.

Another feature that makes the administrator's work easier is the 19" templates. A template contains all technical device data and graphic objects for a particular type of server. If a new device is installed in an enclosure, the system automatically performs a comparison with the templates. If it finds a matching template, it automatically writes all relevant data to the tag. As data-centre operators frequently install devices from a predetermined hardware pool, a small number of templates is sufficient to automatically populate the views.

In addition to the views, charts can be used to visualise the data centre's current physical capacity utilisation. Default charts – line diagrams and at-a-glance gauges – are provided that depict the entire facility's current physical capacity.
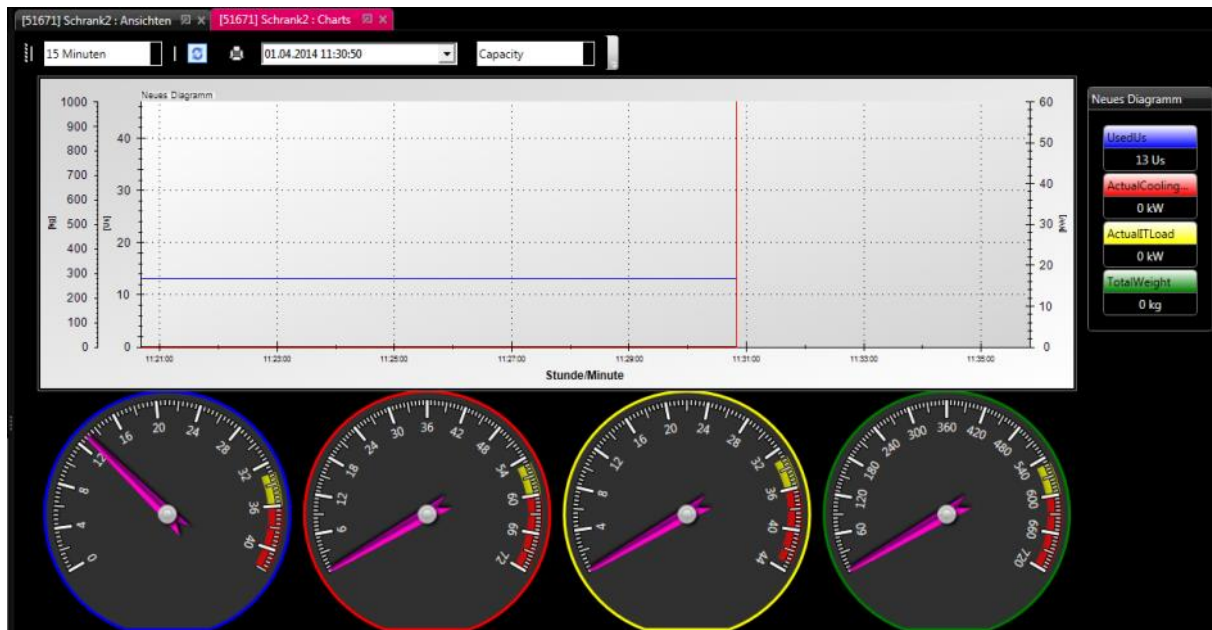
*Figure 18: Default capacity-management charts*

The default charts shown in Figure 18 can be tailored to a data centre's requirements.

The capacity management module offers administrators a live overview of the data centre's physical capacity utilisation. The corresponding data can be maintained either manually or by a fully automated method using DRC.

## Integration with a higher-level management system

### Standard SNMP connection
RiZone offers a standard SNMP interface with associated MIB.

### IBM Tivoli
IBM's Tivoli management software is used to manage servers and the applications running on them. RiZone supports SNMP-based integration with IBM Tivoli. Tivoli users need to be familiar with the RiZone MIB in order to interpret the corresponding alarms and parameter data.

### HP OpenView
HP's OpenView is a comprehensive software package for the administration of server infrastructures and their applications. Its core components are the Network Mode Manager (which monitors network components, i.e. routers and switches) and OpenView Operations (application and system management). RiZone supports SNMP-based integration with OpenView. Users must be familiar with the RiZone MIB so that they can correctly interpret the alarms and parameter data.

## References

*Ref.: 1*      ***THE GREEN GRID DATA CENTER POWER EFFICIENCY METRICS: PUE AND DCiE (Version 2007-01)***

*Ref.: 2*      ***ITIL: How to Manage the Coming Convergence of IT and Facilities (Uptime Institute, White Paper, Tony Ulichine, 2008)***

# Rittal – The System.

## Faster – better – everywhere.

- Enclosures
- Power Distribution
- Climate Control
- IT Infrastructure
- Software & Services

ENCLOSURES     POWER DISTRIBUTION     CLIMATE CONTROL     IT INFRASTRUCTURE     SOFTWARE & SERVICES

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