White Paper

RiZone – The Rittal Management Software for IT infrastructures

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List of abbreviations

BACnet	Building Automation and Control Networks
CMC	Computer Multi Control (sensor network system of a data centre)
CMC-TC	CMC Top Control (monitoring system)
DciE	Data Centre Infrastructure Efficiency
ERP	Enterprise Resource Planning
GLT	Building control system
IP	Internet Protocol
LCP	Liquid cooling package
MIB	Management Information Base
NSH	Low voltage distributor
PSM	Modular, plug-in socket strip (Power System Module)
PUE	Power Usage Effectiveness
RFID	Radio Frequency Identification
SNMP	Simple Network Management Protocol
SQL	Structured Query Language
UKS	CRAC system
UPS	Uninterruptible power supply (UPS)
WPF	Windows Presentation Foundation

Summary

RiZone is the next generation of the Rittal Management Software for the IT infrastructure of data centres. RiZone provides the IT administrator with optimum support for mastering the challenges that result from the monitoring and the control of individual devices through to the complete optimisation of the data centre taking account of the economic and ecologic general conditions.
RiZone monitors and controls all IT infrastructure components required for the reliable operation of the servers, storage systems, routers and switches. The tasks include:

- Power supply and power backup
- Cooling production and distribution
- Room and enclosure monitoring
- Data centre security (access, temperature, ...)
- Efficiency and energy consumption

The interaction of the individual works of their data centres, such as IT infrastructure, network, server, facility management, ERP systems, etc., just to mention a few is vital for IT administrators. RiZone offers intelligent interfaces to provide a comprehensive and transparent view.
An automated inventory control system supports the asset management. RiZone administers here the data provided by the Rittal "Dynamic Rack Control" system, an intelligent, 19"-rack-based RFID technology.
An interface to BACnet connects the system to the building control system. This permits even the integration of components, such as room fire extinguishing systems and access control systems.

The modular and scalable character of RiZone permits these to be used by enterprises as varied as small- to medium-sized companies and large international banks while providing highest demands for failure protection and availability.

RiZone can display the total consumption (kW/h, €, CO_2) and the efficiency of the data centre using trend analyses. RiZone allows control circuits to be defined that permit the optimum operating point of a data centre to be set as required. RiZone so permits the continuous optimisation of an IT infrastructure to provide long-term cost saving potentials.

RiZone offers a standard SNMP interface with associated MIB that allows RiZone to be connected to higher-level server or network management systems.

The special RiZone Management Pack developed for the Microsoft Operations Manager permits a close integration. The IT administrator can so monitor and control servers, clients, services and the IT infrastructure from the Operations Manager user interface. All alarm messages of the physical IT infrastructure are forwarded to the Microsoft Operation Manager. Efficiency measurements and trend analyses of the complete data centre infrastructure are visualised in the Operation Manager user interface. In addition, fault messages can now be linked with the affected services of the data centre infrastructure so that the IT administrator can respond proactively.

Introduction

"Energy efficiency", "sustainability", "Green IT" are some of the catchwords that describe the new additional challenges that confront IT administrators. The power consumption during running operations has become one of the major cost factors that needs to be optimised. However, cost optimisation measures must not impair the true tasks of a data centre. The data centre must make the required services available to the end users quickly and with high performance. A high availability and a large protection against failure characterise modern data centres.
Consequently, management software for IT infrastructures must satisfy the various requirements made by the IT administrators. The software must observe, monitor and possibly control all components of the IT infrastructure. A distributed sensor network acquires and displays transparently all relevant parameters and alarms. The connection to the building control system is obviously essential so that all works of a data centre can be acquired.
An optimum concept for the IT administrator is achieved when a comprehensive consideration of the data centre is provided. The same software tools as those used for the IT infrastructure monitor applications that run on the servers.
RiZone, the new Rittal management software for IT infrastructures, is optimally designed to satisfy the needs of the IT administrators. The modular and scalable character of the software permits these to be used by enterprises as varied as small- to medium-sized companies and large international banks while providing highest demands for failure protection and availability.
A close cooperation with Microsoft also permits the close integration of the server and IT infrastructure world so that an optimisation from a comprehensive concept for the complete data centre (services and components) is possible.

Requirements placed on management software for IT infrastructures

The following sections initially describe the requirements placed on management software for IT infrastructures. The component view concentrates on all devices and structures required to operate the active systems, such as servers, storage systems, switches, routers, etc.

The component view

Power supply backup and power distribution

Depending on the reliability requirements, the power is supplied from one or more independent infeeds. To determine the total power requirement of the data centre, the power of the individual phases is measured at the low-voltage main distribution board (NSH). The NSH also distributes the power to the various works within the IT infrastructure.
Uninterruptible power supply (UPS) systems guarantee the power supply. The UPS isolates the primary network, i.e. the cables of the power supplier, from the power supplied to the consumers in the data centre. Modern UPS systems convert the provided primary alternating current into direct current. This direct current is then reconverted on the secondary side, i.e. consumer side, into a pure alternating current without any interference. A battery guarantees the supply of power to the direct current circuit. The battery is used to provide power should the primary side suffer a complete power failure.
A further distribution of the power through to a consumer socket, for example servers, occurs on the secondary side, the consumer side. Intelligent socket systems, such as the Rittal PSM system, allow individual consumers to be switched on or off, and to acquire their current consumer values.

The tasks of management software for IT infrastructures include monitoring the complete chain of power distribution and power supply backup from the low-voltage main distribution board through to the consumer and collecting all relevant parameters.

Cooling production and distribution

Almost the complete power supplied in the data centre is converted into heat in the terminal devices. This heat must be dissipated from the data centre. For this purpose, the appropriate cooling capacity must be generated and distributed in the data centre.
Various procedures are used for this cooling production. Depending on the customer requirement, the optimum use and the most advantageous combination of various technologies must be decided.

Because chillers produce cooling electrically (see cooling enclosure); they are extreme power consumers. Often, however, the ambient cold air suffices to cool warm water sufficiently so that it can be used for cooling a data centre. Given the appropriate control, chillers and free coolers can augment themselves optimally.

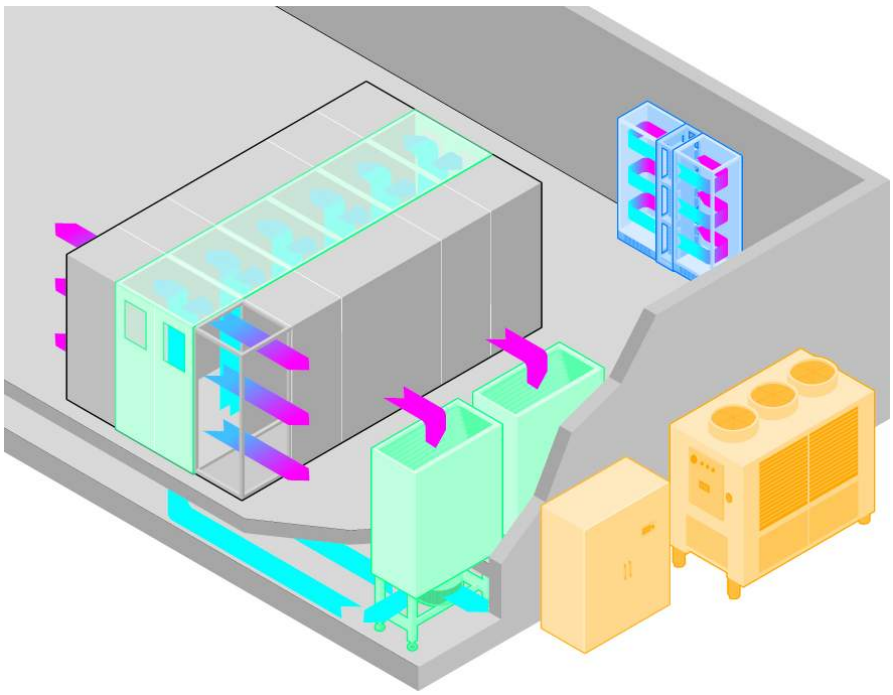

Figure 1: Aisle containment and CRAC system

Pipeline systems pass the cooled water to the data centre. If the data centre has a raised floor, the heat exchangers of the CRAC systems (UKS) are normally supplied with cold water. The UKS draws in the warm room air, cools this in the heat exchanger and blows the cool air into the sealed raised floor. Perforated base plates allow the cold air to exit in front of the server enclosures and will be drawn in by the terminal devices.

We recommend that the cold air be separated from the hot air within the data centre. The aisle between two server enclosures has a roof and doors at the front and back. The hot and cold aisles can also be equipped with sensors to precisely control the temperature change.
For high-performance servers, it is possible to supply the cold water directly in the enclosure suite. The LCP (Liquid Cooling Package) is a heat exchanger that can be installed on the side of a server enclosure. The cold air is then blown directly in front of the 19“ level and is drawn in by the servers. The hot exhaust air is returned to the heat exchanger. This efficient solution works with a closed air circulation in the enclosure. It is also important here that all openings are sealed with blanking panels to prevent any turbulence between the cold air and the hot air.

Management software for IT infrastructures must monitor the complete chain of the cooling production and distribution in the data centre and control appropriately according to the requirement.

Safety components
The tasks of a management software for IT infrastructures also includes receiving and processing all security-relevant information provided by the sensors and possibly used in a secondary action, for example an alarm message.
Wired and wireless networks, such as the Rittal CMC-TC and CMC-TC wireless system, are used at the sensor network level.
Protection against data misuse is one of the most vital security factors in any company. The CMC-TC system regulates access to the server racks and documents access by persons (authentication using smartcard, transponder, magnetic card) or unauthorised access attempts (vandalism sensor). The CMC-TC also uses sensors to record all reliability-relevant parameters, such as temperature, humidity, smoke, airflow and leakage. It also records all consumption values of the terminal devices.

The IT infrastructure management software can also use the CMC-TC system to control the associated terminal devices and, for example, adjust the fan speed or the pump capacity.

Enclosure components
Many of the previously-mentioned sensors are also used in the associated network or server enclosures. However, the enclosures themselves can also be equipped with their own intelligence that then supports the management of the installed terminal devices. The mounting frame of the 19" level must then be equipped with an RFID antenna. The antenna is able to read the RFID tag of a terminal device. This RFID tag is described during the component recognition of the terminal device, for example a server, and so contains all relevant device information, for example serial number, MAC address, power consumption, size in height units, etc.. This allows any addition or changes of a device to be detected by the RFID antenna of the enclosure and forwarded to the IT management software and so permit a dynamic asset management in the data centre.

Room and building components
In addition to the previously mentioned devices of the various works, components from the room and building automation area must also be acquired by an IT management software. Such components include access control systems, room fire extinguishing systems and video monitoring systems, just to mention a few. Whereas the IP-based SNMP protocol popular in IT technology is used in the CMC sensors world, other protocols, such as Barnet, are widely used in facility management.

It can be expected that an intelligent IT management software monitors all components from the IT world and facility management, and displays this information transparently to the IT administrator.

The application view

Network components
Switches and servers are used as active components in the network management area. A switch connects several net segments in a LAN, analyses the incoming data packets and forwards them to the appropriate segment provided it knows the MAC address in its segments. In contrast, routers do not operate at layer 2 but at layer 3 of the OSI model and analyse the complete target address before they forward the data packets appropriately.
Well-known manufacturers of switches and routers also offer an appropriate management software for network components that can be used to configure and monitor the LANs.

Server and storage components/services
The applications and services relevant for the end user run on the data centre servers that communicate with the appropriately configured storage systems.
Experience has shown that the service life of software exceeds that of hardware systems. This means ever faster and higher-performance processor and server technologies are offered while, however, "old" programs must still remain in service. This has made it necessary to use virtualisation to decouple the physical computer hardware from the programs that run on it. The virtualisation software makes it appear to the running programs that it provides the required operating system version, including the necessary computer hardware. This allows very different programs with different requirements to run on the same (hardware) server.
The manufacturers offer the appropriate management software for both the management of the virtualisation and the administration of the client/server infrastructures.

The view for cost drivers and efficiency potentials

The IT administrators now face the permanent challenge to optimise their data centres while taking account of cost and ecological considerations. They are given guidelines in the form of PUE (Power Usage Effectiveness) as defined by Green Grid (Ref.: 1).

PUE – Power Usage Effectiveness

The PUE is defined as follows:

$$PUE = \frac{Total\ power\ consumption\ of\ the\ data\ centre}{Total\ power\ consumption\ of\ the\ servers/storage/switches}$$

The DCiE (Data Center Infrastructure Efficiency) is the reciprocal of the PUE.

$$DCiE = \frac{1}{PUE} = \frac{Total\ power\ consumption\ of\ the\ servers/storage/switches}{Total\ power\ consumption\ of\ the\ data\ centre}$$

The DCiE specifies the ratio between power consumption of the services and total power consumption. Both metrics, however, must observe the following general conditions:

It is only a percentage value not an absolute number. This means the total power of a data centre (kWh, € or CO_2) must be considered in parallel.
To ensure sustainability, the PUE or DCiE must be considered over time using trend analyses.

The critical question is now how the energy balance (and thus the cost balance) of a data centre can be influenced in the long-term. A first step to achieve this is the consolidation.

Consolidation

The consolidation benefits from the virtualisation technology. In this case, modern high-performance servers (through to blade systems) replace the old servers. The virtualisation software installed on the new servers permits the execution of programs that have different operating system requirements. If the "old" systems were previously utilised to only a limited extent, the efficiency of the consolidated systems is significantly higher. This means the consolidation leads to an effective cost saving by reducing the number of servers, and consequently also the power consumption. In addition, each individual server is used more effectively.

If the total power consumption of the servers sinks (as result of the consolidation measures), the total power consumption of the data centre will also be lower because less power is used by the servers and also less cooling needs to be provided by the climatic control units. It is important here to set the optimum operating point so that the cooling is produced to meet the actual need.

Intelligent climatic control concepts

As mentioned previously, the electrical cooling production is a large cost factor in the data centre balance. Intelligent, adaptive climatic control concepts allow long-term savings to be achieved.
If, for the same server load, the cost to produce cooling reduces, the PUE or DCiE can be improved decisively. This, for example, can be achieved by producing cooling naturally, such as free cooling, geothermic, ground water, etc. For example, to use the free-cooling possibility (namely, the production of cooling by utilising the cool ambient air) longer throughout the year, the servers must operate with the highest possible supply air temperature.
An aisle containment, and also the sealing of the spaces between and next to the servers, efficiently prevents the turbulence of hot and cold air. A homogeneous temperature profile with +/- 1 K forms within the cold aisle. The inlet temperature in the water circuit of the UKS systems can be increased. This has the consequence that the free-cooling technology can be used longer during the year.
It is still essential that the appropriate amount of cooling be produced. To efficiently control the generally slow-acting system (inlet and outlet water), the temperatures in the enclosure (namely, in front of and behind the servers) must be measured. An intelligent IT management software now

controls the cooling production and the cooling distribution as required, and permits further saving potentials.

Holistic optimisation of energy efficiency
The IT management software knows the IT infrastructure, the servers and all relevant consumption values. The server management tools know the servers, their loading and the services running on them. On basis of the virtualisation, the services can now be allocated under the aspect of the operating cost optimisation, such as:

- Concentration of the services for night operation
- Weekend operation in preferred enclosures coupled with the reduction of the remaining IT infrastructure
- Move services to enclosures (or even data centres) whose cooling technology permits longer use of low-cost free cooling

This permits the comprehensive optimisation of the data centre taking account of environmental and operating cost aspects.

RiZone – Features

Overview

The necessity for the monitoring of all environment variables in a data centre results from its availability requirement. The IT administrators must satisfy the availability needs (Service Level Agreement) of their end users.
Before a sensor reading or an event can impair the availability of a data centre, all errors and faults must be accumulated.
The addition of warnings or error messages that the data centre IT infrastructure devices send must be logically correlated. Without knowing the direct effect on the operation of the data centre, an error message or warning removed from its context is almost useless.
The aim of RiZone is to convert all messages, sensor readings and actuators into plausible message chains. RiZone breaks down the separation between "IT" and "building". By supporting the two protocols commonly used in IT and building control systems - SNMP and BACnet - we forge a bridge between these two separate worlds. Fusing these two specialist areas allows us to optimise the availability, reduction, complexity and efficiency of a data centre.

RiZone monitors and controls:

- Power supply and power backup
- Cooling production and distribution
- Room and enclosure monitoring
- Data centre security (access, temperature, ...)
- Efficiency and energy consumption

RiZone provides optimum support for all Rittal products from this area. RiZone also supports:

- Asset management/inventory monitoring
- Incorporation of building control systems
- Precise adaptation to requirements thanks to a flexible license model
- High availability requirements of a data centre

RiZone also permits the integration in a management system such as the Microsoft System Center Operations Manager.

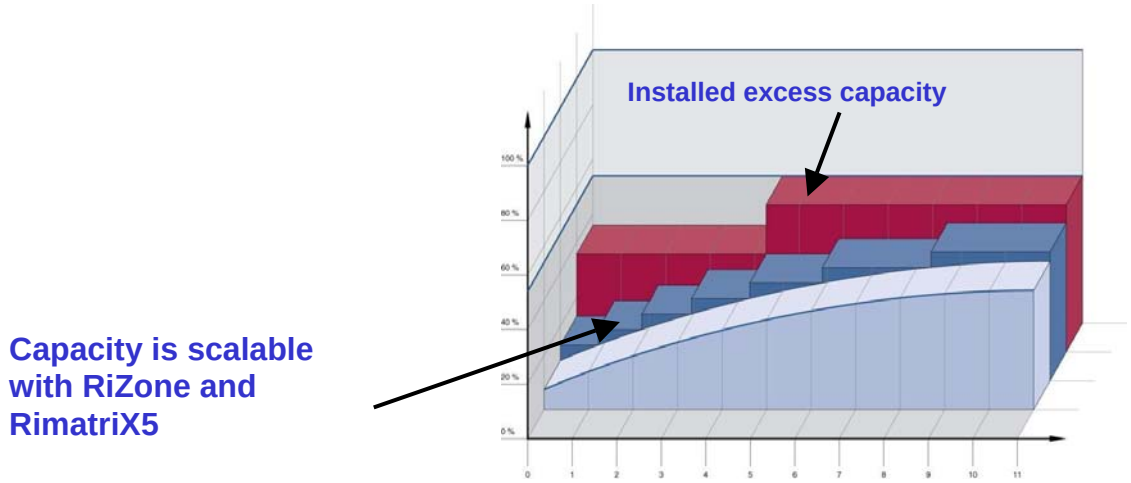

Figure 2: Scalability: Pay-as-you-grow

The RiZone architecture

The following figure provides a general overview of the RiZone architecture.

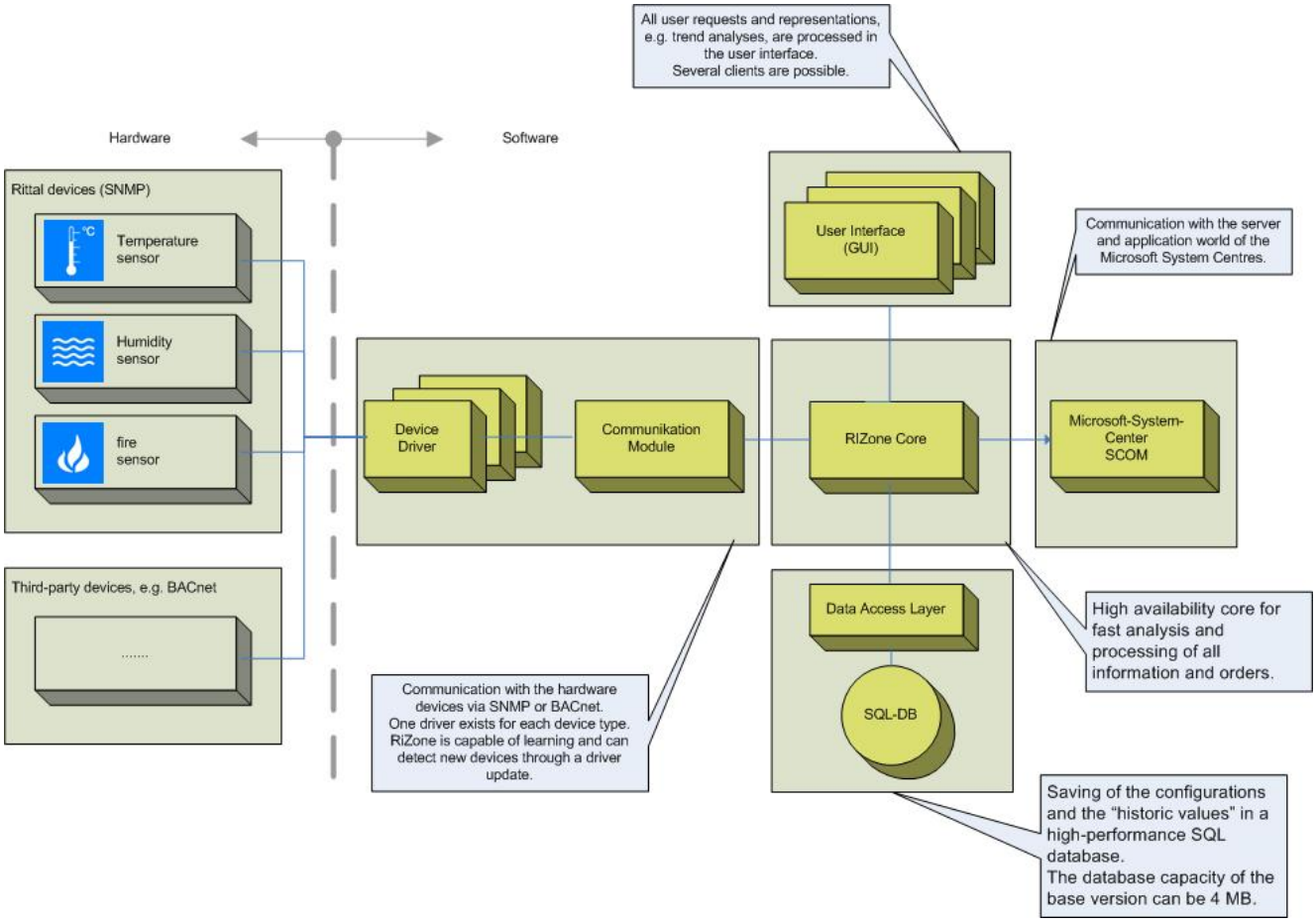

Figure 3: The RiZone architecture

RiZone essentially consists of the following modules:

- **Autodiscovery:** Automated detection of all active RiMatriX5 products and acquisition of their provided parameters (third-party products can be entered and integrated manually).
- **Communication:** Communication with the outside world
- **Core & Database:** High availability core for the fast analysis and processing of all information and orders, and the saving of the configurations and the "historic values" in a high-performance SQL database.
- **Project planning:** The project planning can be used to assign the devices detected in Autodiscovery to the graphic image of the IT infrastructure.
- **Visualisation:** The visualisation module processes all user requests and representations, for example trend analyses.
- **Workflows:** This module allows the user to define individual control loops to not only respond optimally to alarms, but also efficiently set the operating point of the data centre.
- **Administration:** The rights settings, the licensing and the configurations are made in the administration module.

The following sections explain in detail the individual modules with the associated performance characteristics.

RiZone Module – Autodiscovery

With the "Autodiscovery" module, users can automatically identify all active Rittal RiMatriX5 components in the network (sensors, processing units, PSM ...). RiZone scans a prescribed IP address range and tries to contact the components. Based on this identification, RiZone determines which device is connected and which data that device supplies.

The data from the RiMatriX5 world is then forwarded to the RiZone core, where it is processed and saved in the database.

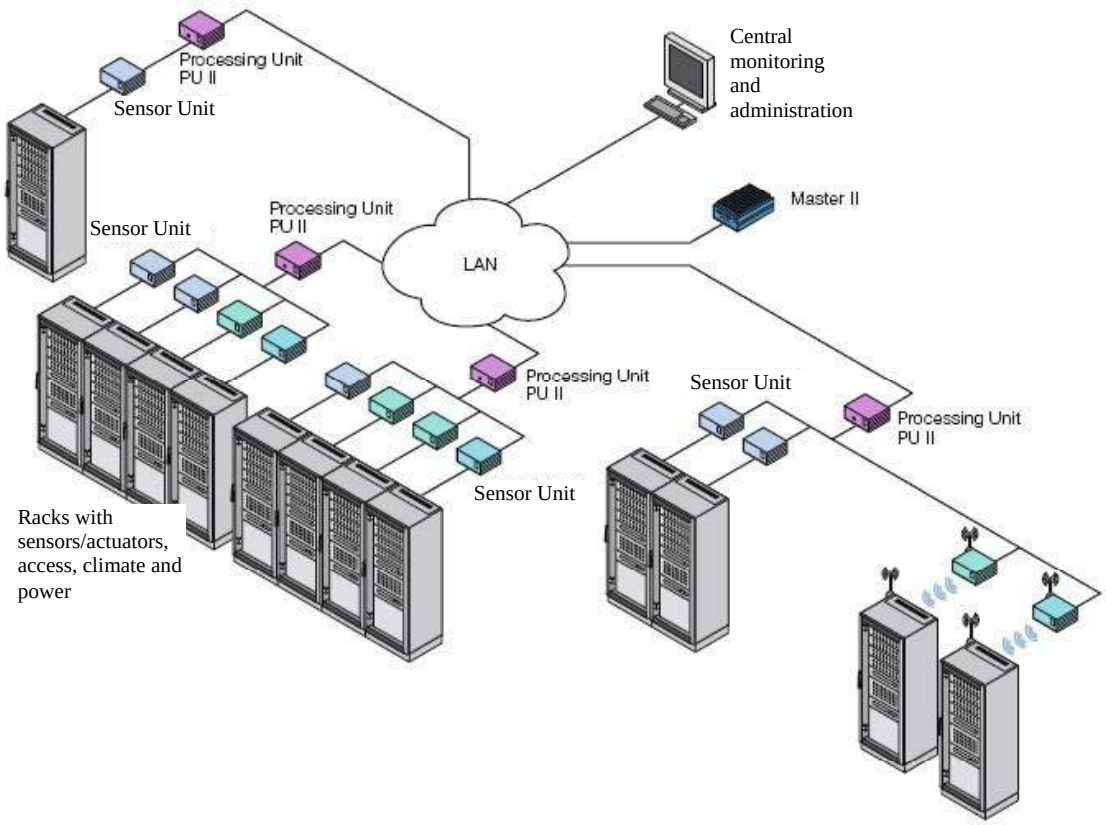

Figure 4: Autodiscovery for RiMatriX5 components

RiZone Module – Communication

The RiZone Communication module provides the interfaces for the external communication. One of the standard interfaces is SNMP.

RiZone Module – Core & Database

The RiZone Core implements the central processing of all events and requests. Events are generally initiated by the change of a parameter in a sensor or a device, and reported to RiZone by an SNMP trap. The core must analyse and evaluate this event and so decide which subsequent actions are required.
If, for example, a temperature value change that lies within the set limits is involved, this value only needs to be stored in the database. If the reported temperature value exceeds a defined limit, the alarm initiated by the CMC must be processed in accordance with the defined subsequent actions.
In contrast, requests to the core are normally made by the end users, in order to query special information, represent data in the required form, change parameters for various IT components.
Both events and requests must be given a priority so that the processing in the Core scheduler can be controlled.

The RiZone Core can also be used to implement the high availability of the system. In a tier II (to tier IV) application, two independent RiZone systems run in a master/slave operation. The synchronisation is implemented using a "heartbeat functionality" between the two RiZone cores. If the heartbeat of the master system does not arrive, the slave system will take over its task. The regular synchronisation of the two systems ensures that the master and the slave have the same configuration and data.

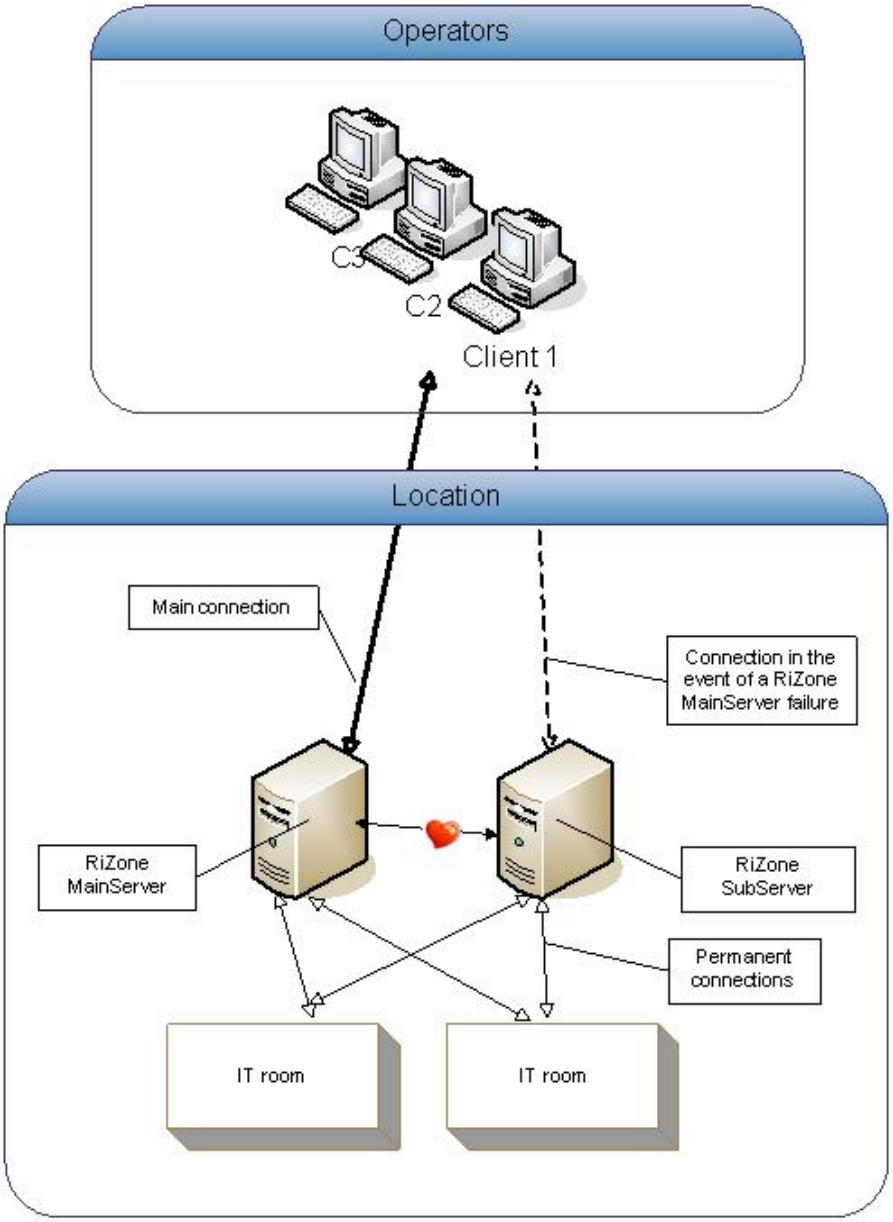

Figure 5: The redundancy concept of RiZone Core

RiZone Module – Project planning

The RiZone project planning module allows users to allocate the sensors and components detected in autodiscovery to real devices/enclosures in the diagrammatic representation of their data centre. Project planning supports a hierarchical company view, so that a distributed company-wide infrastructure may be represented just as well as data centres distributed across several rooms or buildings.

Within the context of project planning, logical relationships must be created between the sensors/actuators and appliances that are monitored and controlled.

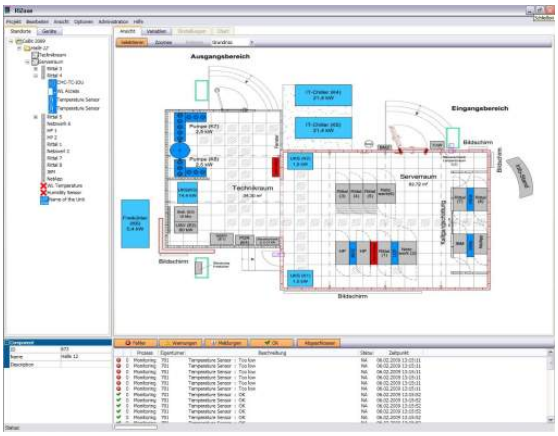

Figure 6: Picture of the data centre infrastructure in Project Planning

For example: RiZone has identified several temperature sensors. However, without knowing the enclosure and position in which these sensors are installed (cool incoming air or warm waste air), the measurements supplied cannot be interpreted.

RiZone Module – Visualisation

With the aid of visualisation, flexible views of data development may be created. Using the software, the user can compile the required graphs himself (number of graphs, colour, time period, ...). In this way, RiZone supports a customer-specific data view.
Based on trend patterns, critical deviations and any potential room for improvement can then be identified.

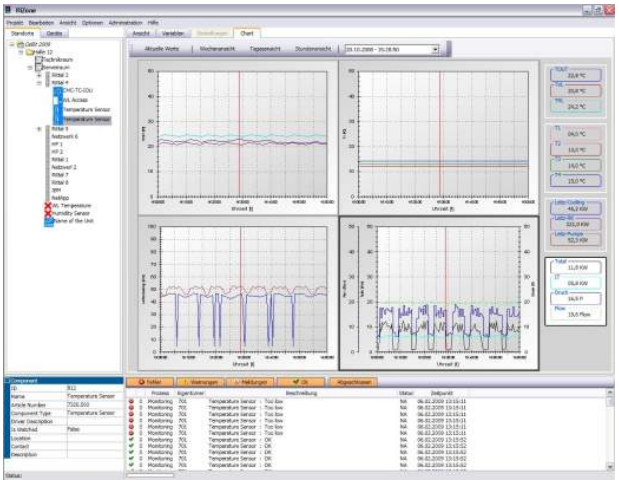

Figure 7: Trend patterns

The RiZone visualisation is based on the Windows Presentation Format (WPF) that belongs to the Microsoft ".net framework".

RiZone Module – Workflows

The RiZone Workflows module allows the user to define individual control circuits. Simple control circuits are, for example, the linking of various events, the resulting generation of an alarm and the notification using predefined message chains (SMS, e-mail, emergency call, fire brigade, etc.).
RiZone can represent even complex control circuits. To optimise long-term the operating costs of a data centre, it is useful to extend the time of use of the free cooling as long as possible. The critical manipulated variables are the air inlet and discharge temperatures of the individual servers. The air inlet temperature is the guarantor that the server can operate in a safe operating temperature range. The air discharge temperature reflects the load behaviour of the server. These two manipulated variables can be used to produce the cooling appropriate for the requirement.
(In previous data centres with raised-floor cooling, a relative slow-acting control circuit is implemented using the temperature of the returning warm air or the temperature of the returning warm water.)

RiZone Module – Administration

The rights settings, the licensing and the configurations are made in the administration module.
Different user groups with different rights can be defined in RiZone. For example, the IT system administrator can own all rights, whereas the janitor/porter can only intervene as observer, such as to be informed about alarms.
RiZone has a flexible licence model that permits the software capability to be adapted to the needs of the individual customers. The licensing is implemented in the first phase using the number of monitored IP nodes, i.e. IP addresses.

Incorporation into superordinate management systems

Standard SNMP connection

RiZone provides a standard SNMP interface with associated MIB.

IBM – Tivoli

IBM provides with Tivoli a management software that manages the servers and the applications that run on them. RiZone supports an SNMP connection to IBM Tivoli. To do this, the Tivoli user must know the RiZone MIB in order to interpret the associated alarms and parameter values.

HP OpenView

HP offers with HP Openview a comprehensive package for administering server infrastructures and their applications, whose most important components are the Network Mode Manager (monitoring of the network components, i.e. routers and switches) and OpenView Operations (application and system management). RiZone supports an SNMP connection to HP OpenView. To do this, the user must know the RiZone MIB in order to interpret the alarms and parameter values.

Incorporation into Mictrosoft Operations Manager

The Microsoft System Center Operations Manager permits a comprehensive status monitoring of IT services, servers, applications and clients. This covers the monitoring of distributed applications with all dependencies. A proactive fault correction and an integrated expert knowledge support the IT administrator here. The high level of automation reduces the complexity, in particular in large distributed systems.
A decisive performance characteristic of the Microsoft System Center Operations Manager is its interoperability and expandability using Management Packs.

RiZone Management Pack

Management Packs contain best-practice knowledge that allows problems of certain components to be detected, monitored and rectified. Management Packs contain state models for the analysis of

- Power
- Availability
- Configuration and security settings
- State of dependent components

A Management Pack also implements the connection to RiZone. The Operations Manager shows here the view of the IT infrastructure as RiZone. All important alarms and relevant parameters from the IT infrastructure are shown in the Operation Manager user interface

- Security information
- Consumption figures
- Efficiency

A RiZone call from the Operation Manager can fetch detailed information.

Features of the integration

Figure 8: RiZone integrated into Operations Manager

The feature scope of the Management Pack and the additional customer benefits can be described as follows:

- Monitor and control of the IT infrastructure (power supply, power distribution and backup, cooling system, security, localisation - room and installation location) from the familiar Microsoft Operation Manager user interface.
- All alarm messages of the physical IT infrastructure are forwarded to the Microsoft Operation Manager.
- Efficiency measurements and trend patterns of the complete data centre infrastructure are visualised in the Operation Manager user interface. For example data centre efficiency, energy consumption, power balance, carbon dioxide emission and refrigeration efficiency.

The customer has additional benefits because of the fact that RiZone is connected to Operation Manager.

- Technical problems / fault reports in the data centre infrastructure can be linked with the affected services.
- Display the free capacities and the currently required resources (electricity, cooling, slots, etc.).
- Optimise service allocation by using information from the data centre infrastructure.
- Service-related billing/reallocation of infrastructure investments.
- Service-related billing/reallocation of running costs (electricity) of the data centre infrastructure.

Literature

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