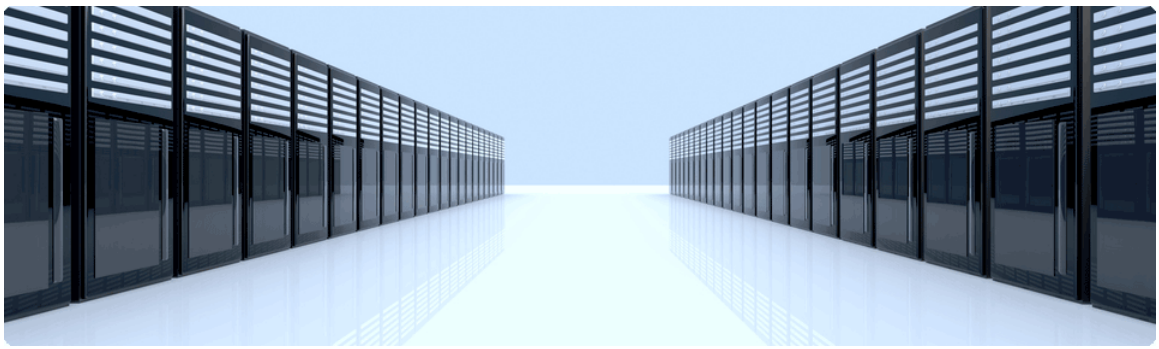
What is a Green Cloud Datacenter?



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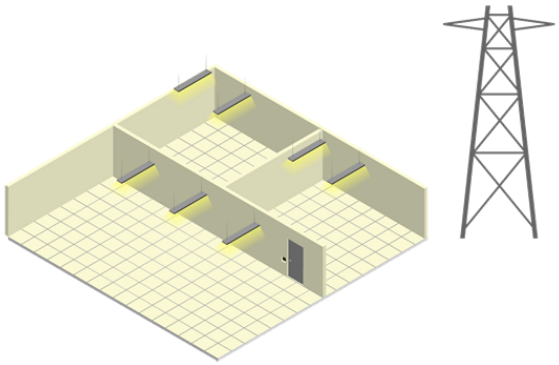
2.1. Introduction

This document will explain the difference between a traditional datacenter and a Green Cloud Datacenter.

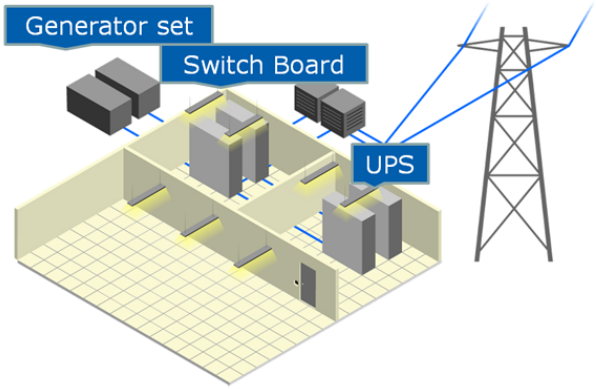
2.2. The construction of legacy Datacenters

Elements of a typical datacenter include:

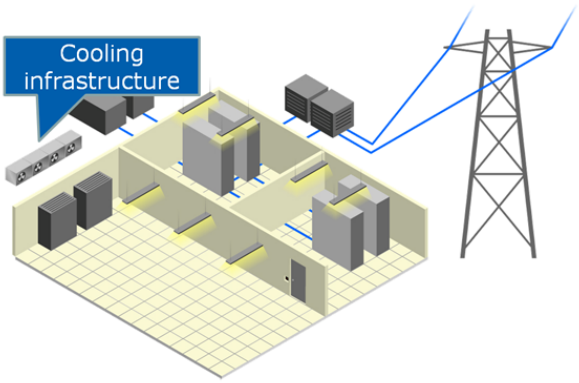
- Building & Power
  - A secure building, fully shielded against environmental influences with no windows
  - 1 or 2 external high voltage power feeds
  - Connection of high voltage feeds to transformers



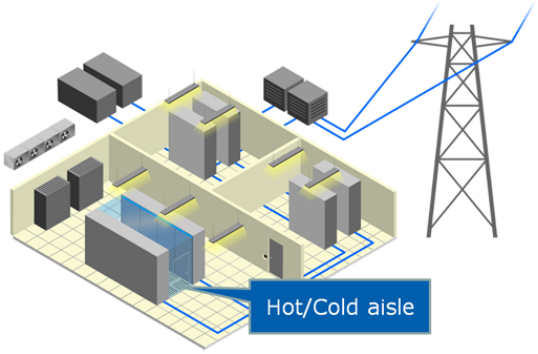
- Datacenter supply equipment
  - Uninterruptible Power Supply (UPS) to provide battery based power for a limited time in the event of loss of the primary electricity source.
  - Switch board room to distribute the power
  - Diesel generators to provide power in case of extended outage from the electricity utility provider



- Cooling equipment:
  - Chillers to cool down water used for air conditioning
  - Air conditioning units below the raised floor
  - Cooled air is blown into the datacenter rooms via perforated tiles



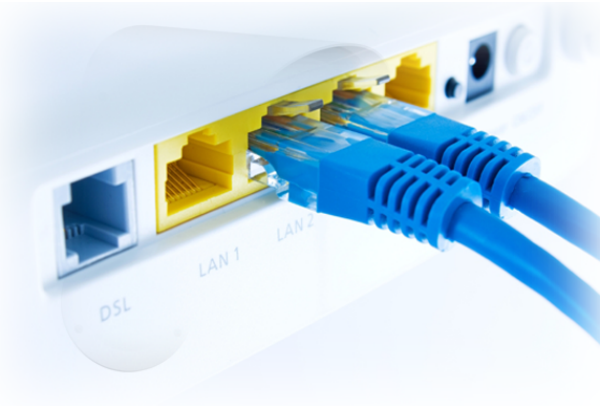
- Colocation rooms:
  - Private rooms (racks for a single customer) or shared rooms (Racks shared between multiple customers)
  - Datacenter customers hire between 1/4 and a full rack
  - Each room typically will include a raised floor with cables and aircon units below
  - Racks installation designed to allow customer servers to benefit from cooled air



- Cable trays
  - Power distribution delivered to the racks
  - Networking connectivity delivered to the racks
  - Building automation functions

- Building Automation equipment
  - Security cameras
  - Physical access security
  - Equipment status monitoring

- Networking equipment
  - Telecommunication Services Provider (Telco) connection point within the building
  - Connections between telco bandwidth and datacenter customers
  - Connections between datacenter customers
  - All connections are manually installed through cable junctions within the Datacenter Peering Room



This typical datacenter layout is often considered as best of breed, mainly because it is the most common design and has been used for many years.

2.2.1. Datacenter Peering Room

The Peering room is a key area within the datacenter for provisioning and managing connectivity between public, private and internal networks. Private Peering, Public Peering, Transit, Dark Fibre, Ethernet, MPLS (Multiprotocol Label Switching) and Leased lines can all potentially connect to the peering room. Private Peering is normally an interconnection between customers within the datacenter and the telcos or between datacenter customers. Public peering is often installed in the datacenter in the form of a public exchange switch so that customers can exchange data without the need to have a private connection.

If two customers in the datacenter want to be form a private peer, a dedicated cable can be run from each rack to a patch bay within the peering room.

The peering room is connected to the telco room that is used to provide external network bandwidth to customers within the datacenter. The high capacity trunk lines, often from multiple Telcos, will enter via this room then connect to equipment used to route the customers' traffic inside the datacenter. Customers peer with a telco that provides transit for data between that datacenter location and the outside world. For this transit service, the datacenter customer pays the telco a monthly fee, often based on a fixed number of Megabits per second (Mbps) maximum transfer rate. The transit agreements often allow peaks for short times or at a variable rate for an additional fee.

2.3. How legacy Datacenters are preparing to become greener

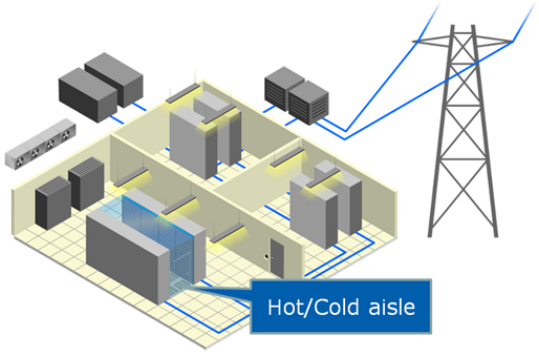
The rising cost of energy combined with environmental objectives to lower carbon footprints has led to much greater demand from both existing and new datacenters for methods to improve Power Usage Effectiveness (PUE).

There are several measures that datacenters are taking to become greener.:

2.3.1. Optimise the air conditioning system

Datacenters have started using hot/cold aisles designs to improve cooling efficiency.

Hot/cold aisle (or hot aisle/cold aisle) is a method of cooling servers in datacenters in which every aisle between rows of equipment racks is bounded with exclusively hot-air outlets or exclusively cool-air intakes. Air is brought into the cool aisles from underneath by perforated tiles and exhausted from the hot aisles overhead. This produces constant air circulation through the racks, provided there are no "holes" through which cool air can leak without encountering hardware.



In a hot/cold aisle configuration, the hot aisles are always at a much higher temperature than the cool aisles. Equipment racks are arranged in parallel rows. Air flows generally upward throughout the center with a constant "breeze" through each row. For optimum design, internal fans that bring air into or exhaust it out of individual units should be disabled or configured to act with, not against, the overall pattern of air flow in the center.

Many datacenters have applied hot and cold aisles but failed to install blanking panels to avoid mixing air. This is often because the building and aircon systems were not designed with hot/cold aisles in mind and cannot easily be modified for this configuration. The disadvantage is that hot / cold aisle still requires a lot of overcooling inside the server rooms which wastes a lot of energy.

When hot-aisle/cold-aisle is installed with raised-floor cooling the combination still causes a lot wasted of cold air. Even with blanking panels and with a laborious process of sealing all the gaps in the floor, there will be cold air in unexpected areas.

2.3.2. Improving the efficiency of UPS and power conversion

A lot of power is lost when converting it from high to low voltage. Datacenters are now investing in equipment that offers a much more efficient voltage conversion process.

However, servers that use low voltage power are still connected to higher 110V (US) or 220V (EU) supplies. The conversion from mains to useable internal voltages can results in a energy loss of up to 30%!

2.3.3. Buying Green power and lowering the carbon footprint

Electrical utility companies offer programs where companies can reserve energy out of their pool of ‘green energy’, often at a special rate. If the power used by a datacenter is generated by green energy, this is often a strong differentiator for customers with a highly focused green strategy. However, there is a danger that if a datacenter is not energy inefficient; the use of “green energy” will be seen as purely a marketing gimmick.

2.4. True Green Cloud Datacenter concept

Dacentec has developed the **'True Green Cloud Datacenter'** concept!

- Green Cloud is **designed by a team of datacenter experts** that has helped build over a dozen enterprise-scale datacenters during the past two decades.
- Dacentec implements a combination of innovations to deliver previously unseen levels of efficiency and reliability.
- Datatec can **reduce the carbon footprint by 75%** compared to similar large legacy Datacenters.
- A source of ideas and technologies to further innovation in the datacenter.
- Dacentec is **fully automated and offers remote control for the entire infrastructure** which makes it ideal for cloud computing and archive storage.

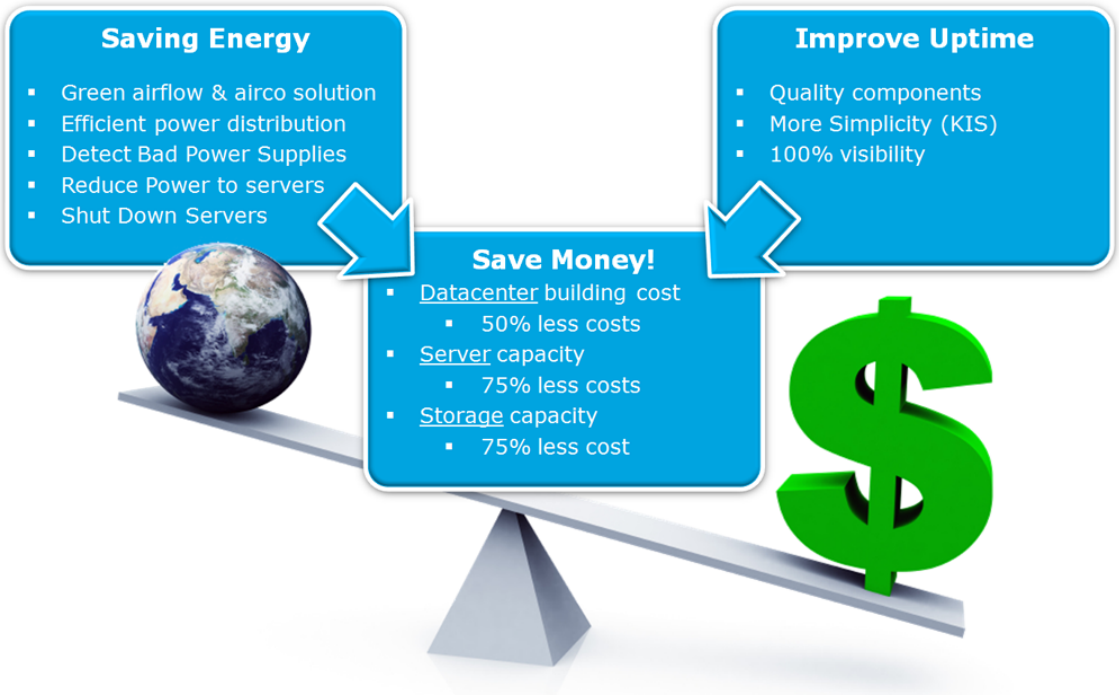
Historically, the team that created Dacentec focused on datacenter automation. More recently, through a number of successful ventures, the focus has shifted to Cloud Computing and Green Datacenters of which automation is still an important aspect.

Around 2005, Amazon took the lead in the cloud computing industry with its S3 and EC2 services. Google (AppEngine) and Salesforce (Force.com) have also become prominent players in the sector. The ecosystem has segmented into Infrastructure as a Service (IAAS), Platform as a Service (PAAS) and Software as a Service (SAAS). Cloud computing is experiencing a growing popularity across all industry segments, with a lot of activity within SAAS top layer.

Despite of all the innovation in the cloud over the past few years, the IAAS layer still faces a lot of issues especially around its Green credentials:

- Power consumption is still at unacceptably high levels; in the space of 3 years, the cost of power has jumped to 50% of hardware costs.
- There are still too many manual processes; we have still not reached the full automated solution as promised by the cloud paradigm.
- Current storage technologies fail to offer low cost, always online, and unbreakable system and are not adequate for cloud storage requirements
- The levels of complexity in the datacenter have not been reduced; most cloud platforms do little more than virtualisation of servers.

Green Cloud Datacenter:



3. How Dacentec builds Datacenters

3.1. How Dacentec is creating a True Green Cloud Datacenter

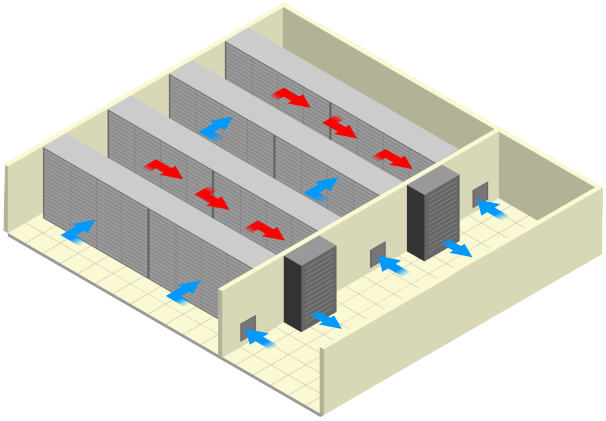
3.1.1. What is a Green Datacenter?

A green datacenter is a repository for the storage, computing capacity and management of data and applications in which the building, mechanicals, lighting, electrical and computer systems are designed for maximum energy efficiency and minimum environmental impact.

3.1.1.1. Ultra-efficient datacenter cooling

For years, hot-aisle/cold-aisle and raised-floor cooling has been the standard method of cooling racks of servers. A traditional set up of hot aisle/cold aisle with blanking panels will probably still waste cold air in places you wouldn't expect.

Dacentec uses a system to contain hot or cold air in a (closed-loop) system by using return-air plenums. A plenum is a separate space provided for air circulation for heating, ventilation, and air-conditioning. To that plenum we add computer room air conditioning (CRAC) units. Hot air naturally rises, so the CRAC units are sucking air in from the hottest part of the hot aisle that is high in the room. The air is cooled down and brought in low into the area of the cold aisle, where is sucked in by the IT equipment and blown out into the hot aisle.



Depending on the ambient conditions of a location, we will use a closed system or the outside air in the cooling process. For using the outside air we implement Air-Side economizers to significantly reduce energy costs. Mechanical cooling, depending on the source, is estimated to consume anywhere from 33% to 40% of a facility's incoming electricity.

The outside air is brought into the building and distributed via a series of dampers and fans. Instead of being re-circulated and cooled, the heated air coming out the IT equipment is simply directed outside. If the outside air is particularly cold, the economizer may mix the heated air and the incoming air, ensuring that the resulting air temperature falls within the desired range for the equipment. The Air-Side economizers include filters to reduce the amount of particulate matter or contaminants that are brought into the datacenter space and also regulate the humidity of the air.

By doing this, Dacentec does not need to use raised floors and saves a lot of construction costs. This method also creates more efficiency across the entire datacenter cooling design. Raised floor cooling can never ensure optimal cooling at each spot and therefore overcooling in many datacenters with raised floors is still a factor in unnecessary costs.

3.1.1.2. Avoiding wasteful over capacity

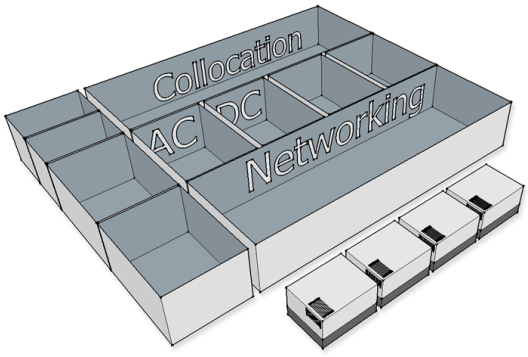
Datacenters are still being built using the largest capacity elements for certain key systems. These items including huge diesel backup generators, UPS systems and air conditioning systems are often not the most efficient or cost effective items to meet operational requirements.

Dacentec saves money and improves uptime within the datacenter by instead using smaller compartments.

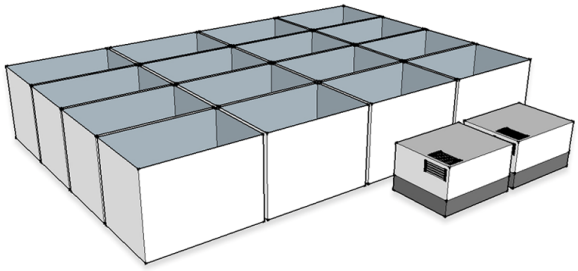
This modular approach allows each compartment to operate independently. In the event of a failure within a compartment, there little chance that the entire datacenter is impacted. Also, the approach of smaller compartments allows use of more cost efficient equipment.

Dacentec can build out a 10.000 m2 datacenter using a modular step by step process. This allows owners to start generating revenues quickly while only adding additional compartments when needed. Using this methodology, the datacenter can scale more efficiently.

Old approach:



Modular approach:



3.1.1.3. Improving efficiency at the resource layer

While most datacenters are considering measures to improve efficiency at the supply side such as power distribution and aircon, it is equally important to consider the IT equipment within the load side. However, within a typical co-location datacenter, it is difficult to gain control over customer equipment.

Dacentec is not selling co-location but instead offers the raw CPU and data storage capacity used by the underlying infrastructure. Dacentec provides a network with access to super fast storage and CPU capacity built on highly optimised and dense hardware. Customers buy dedicated CPU nodes and storage nodes with the flexibility to run whatever operating system and application they require. However, the management burden for maintaining the equipment is removed from the customers.

By controlling the base IT resources, optimisations strategies can go a lot further. For example, datacenter managers can shut down servers when they're idle, reduce CPU power or improve efficiency by moving workloads to more optimal locations. Dacentec uses a power orchestration system that shows not only the overall power consumption but also the individual usage of each server. This allows customers to be charged only for usage which promotes and incentivises to optimisation.

Finally, the power orchestration framework also monitors individual components to aid continuous optimisation. This allows for faster notification of incidents, breakdowns and even helps predict likely breakdowns based on developing trends.

3.1.1.4. Reducing energy loss during power conversion

Power enters a datacenter building at high voltages which are then converted down via many steps for use by various elements across the site. Since each server operates on low voltages (12 to 48V) but the input is still 220V (EU) or 110V (US), another wasteful power conversion process is required. These steps, especially the last conversion inside each server, can result in a 30% energy waste. Dacentec reduced this conversion loss by connecting servers directly to low voltage power supplied directly inside the racks.

3.1.2. Cloud

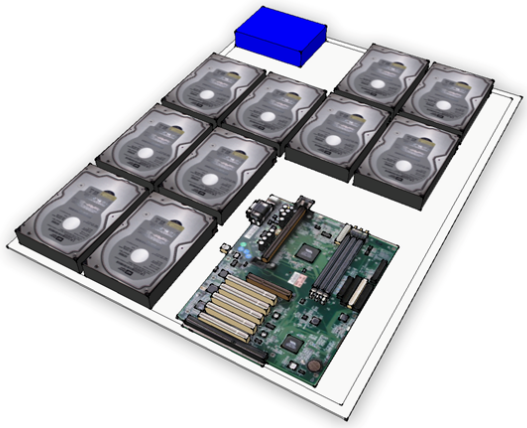
Next generation cloud datacenters move away from traditional housing or co-location towards delivering ‘ready to use’ resources for computing while allowing customers the choice of applications. By switching to a utility model, the cloud datacenter can significantly reduce costs, lower energy consumption and improve IT availability.

3.1.2.1. Deliver High performant IT capacity

Dacentec has developed its own high density equipment to deliver the base storage and computing capacity for datacenter customers.

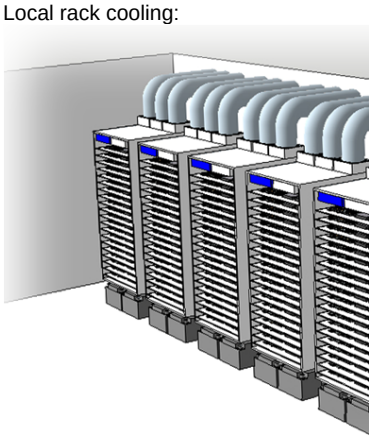
This high capacity model uses a custom rack and server design including plate racks and plate servers. The principle is simple: Everything is stripped down to the essential high performance components without the need for server casing or power cables with plates simply clicking into a a common power bar. This innovative plate design offers higher density than any standard servers on the market! In order to achieve optimal cooling, the air cooling can be installed on the racks itself.

High density storage plate:



Rack filled with plates:

Local rack cooling:



3.1.2.2. Implementing Full Automation

A Cloud Datacenter needs scale to eventually manage Petabyte’s of data (1 Petabyte = 1024 terabyte = 1 million gigabyte) and Terahertz’s of CPU power without constantly increasing management costs and complexity.

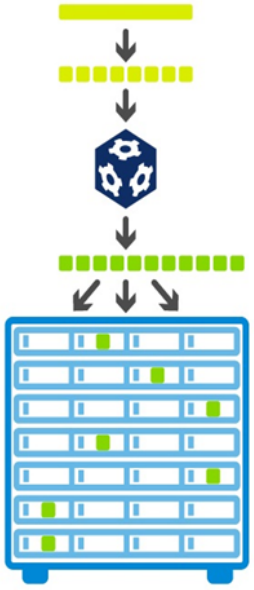
Dacentec uses an intelligent automation frameworks to manage and monitor the installed equipment with the ability to drill down through the management interface to provide details on even the smallest element. The automation layer helps the datacenter grow without incurring downtime or complex procedures.

3.1.2.3. Switching to scalable and unbreakable storage

Current public clouds such as Amazon S3 have an easily identified cost per gigabyte data storage pricing models. However, the overall cost compared to the actual price of raw hard disk capacity is still relatively high in absolute terms.. The primary reason is the limitation in scalability and the lack of high speed / low latency networking techniques required to access data.

Dacentec is solving this by integrating technology from its sister company Amplidata that brings a solution to managing huge data capacities within a cloud datacenter. Customers can access high capacity storage volumes of up to 100TB through high speed connections at the lowest cost per capacity price point within the industry.

Amplidata uses an innovative distributed architecture that is considerably more reliable than traditional RAID based storage systems without incurring extra costs. The diagram highlights how data is coded and spread out to multiple disks at different locations. However, only a few of the disks are needed to rebuild the data!

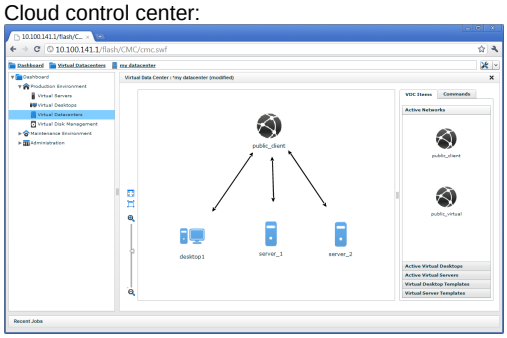


3.1.2.4. Go beyond standard datacenter automation

Dacentec integrates A-Server`s & Incubaid cloud automation framework allowing customers to create, manage and monitor their infrastructure while retaining freedom of choice for the customer.

The diagram shows the cloud control center that allows easy management of the infrastructure by customers.

Cloud control center:



3.2. Dacentec supports Best Practice Standards

Along with the specific cloud and green measures, Dacentec also applies the following best practices in each of its Datacenters:

- Building selection process
- Crossing of power grids
- Availability of fibre
- Fully redundant setup:
  - Redundant generators
  - A and B feeds
  - Diverse fibre entry using different sides of the building
  - Redundant UPSs
  - Redundant cooling
- Fully secured: Iris scan, Finger print, CCTV security
- No customers access policy: Since the raw material are already provided, there is no need for a customer to enter the datacenter

4. Article Contributors

Wilbert Ingels - CTO

Wilbert Ingels has 16 years of experience in the IT and Telecom sector. Before starting with A-Server he was: Sales Director at Netcom Solutions and Level3 Communications Inc., European Director Business Development at Level3 Communications Inc., Vice President Sales at Dedigate/Terremark Inc., Senior Vice President Managed Hosting Dedigate/Terremark Inc., COO Europe at Dedigate/Terremark Inc.

Wilbert is an engineer by education and an expert in datacenter design and power management. He invented several new concepts regarding power management in datacenters. He has several patents on his name for datacenter power technology designs.

Next to his power expertise, Wilbert has experience as CTO in previous ventures for multi datacenter design and management, data replication methods, datacenter security, high volume infrastructure setups and disaster recovery in and between datacenters.

Wilbert is one of founding partners of Dacentec and is co-founder of Dedigate, Racktivity and A-server.

William Groh - VP Operations

William Groh - US Operations

William Groh has 15 years in the Systems / Network / Internet industry and suited for senior level engineering as well as people and project management. Groh specializes in host and network security, internet working and platform integration as well as supporting standards based scalable technology in the enterprise or data center environment.

His background includes Datacenter move, build out, operation and optimization, disaster recovery planning and testing and administrative task automation, Service provider IP network design using Cisco, Juniper, 3com and other equipment, network security design and assessment, IT process automation, Linux / Microsoft integration and VOIP.

He has a proven track record in engineering complex solutions. He has coordinated team efforts for design, implementation, and action recommendation on a wide range of systems.

Before William held managing positions at Telefonica USA where he was Datacenter architect, Diveo where he had built a network of datacenters around Latin America of 100,000 to 150,000 SF size, Performance Fibers, Lucent Technolgies and several other networking/datacenter companies.

Arvid Fossen - Marketing Director

Arvid Fossen is a cloud computing market expert and has been a speaker and contributor at many cloud computing events worldwide. He has built his experience in this area at cloud computing solution vendor CloudFounders. He and his team delivered CloudFounders first private cloud solution. This cloud is a turnkey solution that includes hardware, cloud OS, control panels and API's, providing real agility via auto provisioning, self-healing, high redundant storage and scalability functions. CloudFounders delivers the cloud in their customers datacenters that can use that cloud to offer renewing pay as you grow and pay as you use hosting offerings, but also to built out web 2.0 projects and scalable storage.

Previously Arvid has held manager roles at Hostbasket, one of Belgium's leading companies in hosting that has been recently acquired by Telecoms Operator Telenet. At Hostbasket Arvid was responsible for product launches and executing strategic projects in the messaging and collaboration products.

Arvid started his career at Belgacom, Belgium's largest Telecoms Operator. Within Belgacom's wholesale division he was responsible for the product management of the local loop unbundling including ADSL and SDSL and also managed wholesale contracts for Belgacom's ATM Backbone network.

Arvid has a Master degree engineering from the Antwerp University and attended a Master Class marketing at Solvay.

Arvid is an Entrepreneur In Residence from Incubaid. Arvid is now one of the founding partners of Dacentec and was co-founder of CloudFounders before.