



Case Study  
 Intel® Itanium® processor  
 Intel® Xeon® processor  
 Data Centre of the Future

## The Coolest Data Centre

### Dutch Telco, KPN, turns to Intel for insight into future data centre developments

KPN is a leading supplier of telephone, Internet and television services in the Netherlands. Business customers, both within the Netherlands and internationally, are provided with a wide range of services from voice, Internet and data services; to fully-managed outsourced IT solutions. As of March 31, 2007, KPN had 6 million landline voice subscribers, 8.7 million mobile customers and 2.3 million Internet customers in Holland, and 15.6 million mobile customers in Germany and Belgium. In response to growing customer needs, the company wanted to explore new data centre models that would meet environmental and cost challenges, while ensuring reliability for at least 15 years into the future.




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#### Challenge

- **KPN needed to develop a new data centre model** in response to existing customers' growing needs and new customers coming to the company. This placed higher demand on computing resources, responsiveness and requests for new services
- **Energy costs are rising inexorably** and KPN not only wanted to cut down on its power consumption but also meet its own environmental goals to reduce CO2 emissions
- **To ensure both cost and environmental efficiency** the data centre needed to be operationally effective for at least 10 to 15 years

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#### Solution

- **KPN engaged with Intel** for insight and advice. In turn, Intel arranged for a visit to Intel's Data Centre of the Future in Oregon, USA
  - **KPN explored the benefits of end-to-end innovation** at the Intel data centre and gained confirmation about the value of thermal planning, which it had also been evaluating in the Netherlands
  - **It designed a data centre based on Kyoto Cooling\***, a cooling method which doesn't require the use of power intensive compression/condenser units
  - **Intel helped KPN develop a 'real-life' data centre** by providing servers that simulated load-bearing capacities and heat generation
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"Applying Kyoto Cooling\* will lead to dramatic data centre cost-savings."

Frans Sas,  
 Project Manager, KPN

### Assessing the Situation

A key element of KPN's offerings is outsourced data centre services. Customers are typically high-profile blue-chip clients, and demand for its data centre services is set to grow considerably in the coming years. But KPN understood that its existing data centres would not have sufficient capacity to handle the surge in demand. It could have built a series of new data centres, but wanted to develop a new model that would factor in rising energy costs and growing environmental concerns, and could be rolled out in the Amsterdam area.



# Unique cooling mechanism transforms data centre energy requirements

As the company began researching its options, several employees who had earlier attended an Intel-led seminar on future data centre practice, pointed to best practice perspectives recommended by Intel. Following engagement with Intel, a trip was arranged for KPN engineers to visit Intel's Data Centre of the Future, in Oregon, USA. The KPN engineers saw how a series of end-to-end innovations were utilised to create a data centre that, among other things, cut down on energy consumption, reduced CO<sub>2</sub> output and improved efficiency. Additional features included simplified management, server virtualisation and improved power and thermal planning.

The KPN engineers returned to the Netherlands with a strong impression of how innovative concepts and technologies could meet KPN's needs, especially in the area of thermal planning and the benefits of separating hot and cool air streams. This approach resonated strongly as engineers had already been exploring the potential of a similar approach embodied in a technology called Kyoto Cooling\* from Uptime Technology.

Heat exchange wheel technology, the basis of the Kyoto Cooling technology, has been available for half a century

## Spotlight: KPN

- KPN is a leading fixed network telephone, Internet and television provider and the major ICT services provider in the Netherlands, Germany and Belgium.
- It has 6 million landline voice subscribers, 8.7 million mobile customers and 2.3 million Internet users in the Netherlands, a country with a population of approximately 16 million. Over 15.5 million customers in Germany and Belgium are mobile subscribers.
- It has a thriving business operation with many blue-chip organisations taking advantage of its services which also include fully-managed outsourced IT solutions.
- The company's history can be traced back to 1852 when the Dutch government began the construction of telegraph lines.

and is applied in air conditioning installations in numerous buildings all over the world. However, applying Kyoto Cooling technology in a data centre represents a striking departure from traditional methods, which are typically based on the same principles found in household refrigerators.

For example, approximately 95 per cent of electricity used by data centre servers is converted into heat. To ensure that servers do not overheat, cold air is blown into the server room. When it mixes with the heat it effectively becomes warm air. A condenser unit, usually situated on the roof, evaporates the heat to the outside. While this method has been used as an effective cooling process for years, it's also energy intensive in that compression/condenser units have to be powered for 24 hours. As energy costs continue to surge upwards and data centre capacity inexorably increases, operational costs become more and more prohibitive.

The Kyoto Cooling solution however brings two major changes to this situation:

- 1) Cold and hot air are separated on the data floor.
- 2) Hot air is fed through a heat exchange wheel and led back to the cool area of the data room.

Kyoto Cooling uses a modified heat exchange wheel that rotates slowly and is cooled by the outside air. Importantly this solution doesn't require the use of power-hungry compression machines as cool air supply for the data room is provided by the heat exchange function from the wheel.

For approximately 97 per cent of the time air temperature in the Netherlands is below 22 degrees Celsius. This is the maximum outside temperature to ensure the correct temperature for the 'make-up' air (between 20-25°C) required for cooling the data centre. Furthermore, as well as being environmentally friendly, the Kyoto Cooling delivers significant power savings.

Galvanised by the thermal planning at Intel's Data Centre of the Future and the potential of Kyoto Cooling, KPN engineers set about converting an old building into a data centre test environment. To ensure an accurate simulation of real-life data centre conditions, KPN asked Intel to help develop a load-bearing test.



**“These data centres will make an enormously positive environmental impact.”**

Frans Sas,  
Project Manager, KPN

## Delivering the Solution

Intel sourced 39 servers from the Intel Winnersh Test Labs and 15 from the Intel EMEA Demo Depot. These included Intel® white boxes, IBM X-Series\* 370, Compaq DL580 Stress Testers\*, Itanium®-based Workstations and Dell PowerEdge\* 8450 among others. The majority of the servers were powered by Dual-Core Intel® Xeon® processors 5000 series, Dual-Core Intel Xeon processors 5100 series and Dual-Core Intel® Itanium® 2 processors.

Frans Sas, Project Manager at KPN, explains: “We then built a frame and added into this environment about 300 household heaters. The aim was to run the servers at deliberately high operational standards and together with the heaters generate as much heat as possible to test Kyoto Cooling\* to its limits.”

By using Kyoto Cooling in the 100 square metre data centre test site, warm ‘exhaust air’ typically at a temperature of 28-37°C passed through the continually turning wheel. The air is cooled as it passes through the wheel. As a result the wheel is heated up. Cold outside air, which is separated from the inside air, is used to cool the heated wheel. The warmed up outside air disperses around the building; the cooled air is led back into the data centre via a separate duct, to be used for cooling. The cooled air is between 20-25°C, the optimal temperature to cool ICT equipment.

Essentially, a continuous stream of air circulates through both the heat exchange wheel and the ICT equipment in the data centre, maintaining the

optimal working environment for the ICT equipment. This also effectively eliminates hot spots which are a common problem in data centres that are cooled by traditional methods.

In a data centre which is cooled by traditional methods, there is an average energy factor of 1.5. That is, for every 1kw of system energy generated, 500 watts of cooling energy is required. For a data centre of 10,000 square feet, over a year, this translates into 104GWh.

In contrast, a data centre with Kyoto Cooling will have an average energy factor of 1.09; which represents a 20GWh requirement for a whole year. The result is a huge 84GWh annual saving compared to traditional data centre cooling techniques.

The enormous reduction in the amount of energy required to cool the data centre equates to an annual financial saving of approximately EUR 8.4 million (USD 12 million). In terms of CO2 savings, annually this is approximately 51,200,000 kg of carbon. Sas adds: “To put this in perspective you need to understand that a single fully-grown tree absorbs on average between 20-25 kg of CO2 every year.<sup>1</sup>

“Clearly our decision to build a data centre using Kyoto Cooling is more than vindicated by these results. We can make huge energy savings while meeting our environmental goals, increasing data centre reliability and reaping large cost benefits.”

### Key Technologies

- Kyoto Cooling\* – a cooling solution that cools data centres without mixing inside and outside air, and without the need for a complex cooling factory that has to be active most of the year
- Banks of servers powered by an array of Intel® processor technology, including Dual-Core Intel® Xeon® processors 5000 series, Dual-Core Intel® Xeon® processors 5100 series and Dual-Core Intel® Itanium® 2 processors
- A bespoke construction using 300 household heaters to simulate heat generation and hot spots found in conventional data centres

### Integral Answers

- Intel Data Centre of the Future Solution confirmed for KPN the value of innovative approaches to data centre design
- Intel and KPN explored new thermal planning models, including the separation of outside and inside air streams, for energy cost savings, efficiency and environmental friendliness
- Worked together to simulate real-life data centre environment in test centre featuring Kyoto Cooling

<sup>1</sup> [www.treesftf.org](http://www.treesftf.org)

# Over EUR 8 million saved every year on energy costs and CO2 emissions dramatically reduced

## Concluding

The Kyoto Cooling\*-based data centre is a clear success for KPN, who now plan to build several new data centres in the Netherlands using the design. Frans Sas, said: "The data centre was built using a modular design which makes it very easy to roll out across other sites, which we are now doing."

The enormous cost savings and significant environmental contributions will also act as a spur to attract further business. "We set out with the intention of developing a data centre that would be suitable for future operations. We've not only achieved that, we've also developed a data centre that will certainly attract more business, due to its increased efficiency, lower operating costs and positive contribution to the environment," says Sas.

Though KPN was already exploring the potential of data centre thermal planning, Intel's input and advice galvanised its thinking and helped propel it into action. This preliminary advice and help with developing a real-life load bearing data centre simulation for the data centre with Kyoto Cooling was central to KPN's decision-making process. Sas anticipates the relationship will continue into the future with the exploration of further advances in data centre cooling technologies.

**Find a business solution that is right for your company. Contact your Intel representative or visit the Intel® Business/Enterprise Web site at: <http://www.intel.com/business/server.htm>**

## Return on Investment

- KPN will save an estimated EUR 8.4 million (USD 12 million) on energy costs, based on the energy typically required to cool a 10,000 square metre data centre
- CO2 savings every year are approximately 51,200,000 kg. To put this in perspective a full grown average-sized tree typically absorbs between 20-25kg every year
- KPN says for a 10,000 square metre data centre, on average 104GWh is required to maintain optimal operating temperatures. In contrast, its data centre with Kyoto Cooling\* requires an average 20GWh every year, representing a huge 84GWh annual saving
- The KPN data centre with Kyoto Cooling is based on a modular design, enabling the company to build new data centres based on the same principles, with minimal planning and relative ease



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