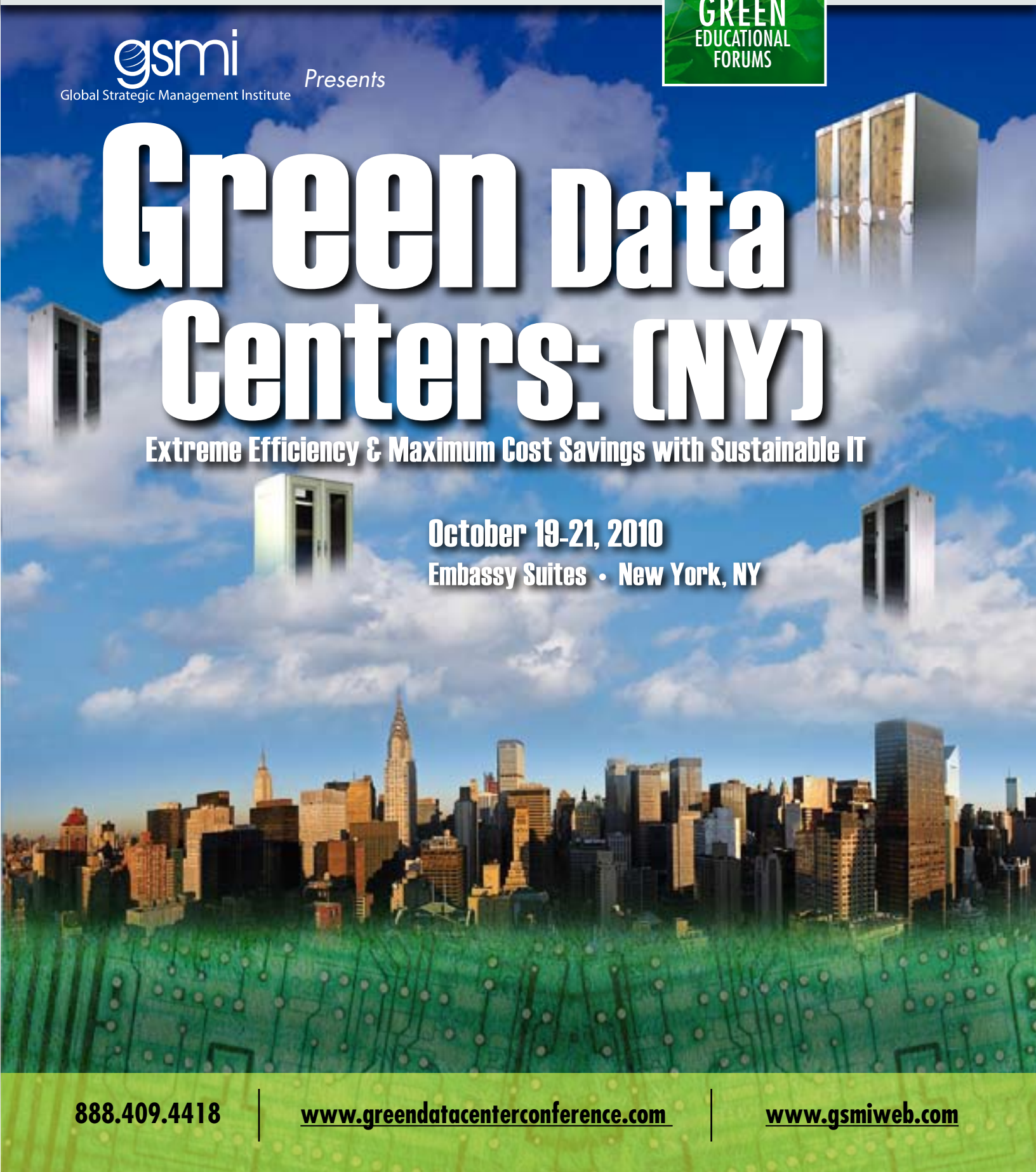
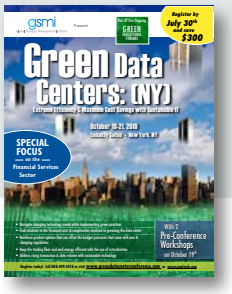
Executive Summary





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Green Data Centers: [NY] Extreme Efficiency & Maximum Cost Savings with Sustainable IT

October 19-21, 2010 | New York, NY

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OPENING PANEL: 5 Key Steps to Achieving Energy Efficiency in the Data Center

WHAT MAKES DATA CENTERS EFFICIENT TODAY AND IN 5 YEARS:

1. Understand exactly what you are doing in a data center - what's the actual work load, how much energy are you using --> will be understood better in the future
2. Data centers won't need chillers only outside air. Won't need humidity controls in 5 years. Like the phone there's more compute information. Computers don't need coddling. Won't have massive data centers. Will be very efficiently run.
3. Server will change dramatically. Rack with high voltage that won't need cooling.
4. UPS generally run on a specific load but now can design UPS systems that can cycle and load --- very exciting thing coming down the pike
5. Data Centers with 10,000 servers and above consumer 4x more energy than Walmart does and doubles every year. Data Centers will be consuming just as much carbon as airlines soon. Looking at incredible growth and demand of IT services. Approaching era of data factories.
6. People are becoming green because the thought of putting 10 million into building a new data center is huge. Being Green saves you green.
7. Moving to cloud version. Morgan Stanley is one that is moving to the model.
8. From utility side - barrier = data centers are split between IT and facility side.
9. Rebate and incentive are great way's to save.
10. Data centers are an opportunity for significant savings.

HOW DO WE GET TO BEST PRACTICES TODAY:

1. Treat data centers as a unit and look at all inputs. Take away organizational inefficiencies - this is the largest barrier to get things done today.
2. Can build 3 centers in 3 parts of country with no UPS or chiller plant but far better and costs less. This is better than a tier 4 data center. Even if one shuts down the other ones can ramp up or they can run at part load. Don't need Fort Knox data centers. Spreading out your load across different parts of the world.
3. Don't coddle your equipment.
4. Servers have an off button. Can dynamically turn things on and off. Should be doing this.
5. Different industries have different applications. Financial industries have to be within a certain region so hopefully the process will evolve. Look at how different industries can develop.
6. Try to bring reliability in operations into methodology of saving energy.
7. It's about making baby steps. Go look at what equipment is being used. Asset list, what hasn't been used etc.... Turn off what you're not using.
8. Don't hold yourself to the same standard as Google, Facebook, etc...Keep an eye on your organization. Yes you can follow guidelines of the bigger companies but remember you aren't them.
9. Cultural barrier inside companies that want to be efficient and save money. Stuck because different groups don't know how to work together very well. Visibility and education are critical.
10. Think of the data center as the server.
11. The more efficient your data center the cheaper it costs to run and build. But always more available.

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Keynote: A Data Center Crisis... or Opportunity? Hardware as the foundation for Data Center Efficiency

GLOBAL TECHNOLOGY GROWTH:

1 Billion New Connected Users = More users

10 Billion Connected Devices = More Computing Devices --> People own multiple devices = amazing increase in traffic.

800 TBytes up Traffic 60 EBytes Data Stored = More Data ---> Large increase in size and compute capacity needed.

A DATA CENTER CRISIS...OR OPPORTUNITY?

Wake up call that a lot of energy is being used in Data Centers. Performance was prioritized over efficiency.

REQUIREMENTS FOR CLOUD DATA CENTERS:

Efficient: World class Energy Efficiency

Simplified: Flexible Intel, Architecture, Infrastructure and a Unified Network. Look at data centers today it's a complex world and to manage it, it needs to be simplified.

Secure: Data Protected at Rest and in Flight

Open: Multi-vendor Innovation and Solution Compatibility --- if not open and don't have ability to interoperate you cant burst data to another center.

Note = Not everything will go into the cloud (customer data and core application probably won't go there)

SERVER REFRESH EXAMPLE IN 2010

*Most important thing you can do in data center = Refreshing. Look at your refresh cycles and compare TCO of 6 and 4. 4 year is recommended. Go back and re-calibrate power and cooling. This will drive down the entire cost of the data center. Think through the entire equation.

XEON PLATFORM EFFICIENCY TRENDS

Performance has gone up

power at 30% utilization has gone down

Efficiency has gone up

This is why they deliver refresh rates. Doubling performance every 18-24 mnths and focus on energy efficiency.

SERVER EFFICIENCY FOCUS - GLOBAL IMPACT

By 2016.....

Number of servers increases 1.5x = incredible increase in performance

Compute capacity will grow 9x

Total energy consumption will stay constant.

40% reduction from where K projected data centers would be

They believe tide is turning, people are smarter, refreshing more often. Doing more with a single box. They think that there is more to do. Everyone in NYC is worried about capacity and what else they can do.

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WINSTON: GATE TO GRID EFFICIENCY

Has been working on technology strategy.

Philosophy = look at system as a hole from power grid to the gates.

ENERGY PROPORTIONAL COMPUTING

Computers aren't really used at 100% of their peek capacity. In fact most are used well below their peek capacity. Average system utilization can be very low, 10% range, it can be in the 30% for enterprise applications, high performance could be high.

What Intel wants to do is make sure it scales. Idea behind that is Energy Proportional Computing = look at range of server utilization - how much power does it consume.

Idle = less

fully utilized = more

SERVER COMPONENT SCALABILITY

Curve that looks at all components inside the server. What contributes to the energy consumption

Consume large amounts of power when system is sitting doing nothing. Burning energy without actually doing anything.

Big success for them was Memory = now they have, if memory isn't doing anything the memory shuts down to low power work load but resumes almost immediately when needed.

CPU = working on ways to bring that down but the scaling is pretty good. You want, as a computer, the actual work being done in the CPU. Power consumption should be in CPU

SCALABILITY OF XEON-OUTCOME OF WORK THEY'VE DONE OVER FEW YEARS.

Bottom line of chart = is measure of performance of the computer = how much compute is the platform able to provide.

Left part of chart = Power: Lower is better. Maximum work load - No work load

Moved from single core to multi core= If you have two cores you can run them at half the frequency. If you double the cores and cut frequency in half you drop the power consumption by the power of 4.

More proportional scaling of platform = introduced memory power management. Look at CPU as the master. Increase the amount that CPU can drive. Power management delivers increased scalability.

When computer doing no work it should be using no power

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DATA CENTER EFFICIENCY FROM "GRID TO GATE"

Distribution - Power Usage Effectiveness

Facility-Power Usage Effectiveness

Rack and Row Level Infrastructure-Power Usage Effectiveness

Server Power Supply - climate Savers & Energy Star, SPEC power, SPECWEB

Fans and cooling-Energy Star, SPEC power, SPECWEB

Motherboard VRS-Energy Star, SPEC power, SPECWEB

Package - losses to worry about relatively small but ultimately impact thermal level-Energy Star, SPEC power, SPECWEB

Die-Energy Star, SPEC power, SPECWEB

Gates-Energy Star, SPEC power, SPECWEB

PUE = once you get down to 1.1 or 1.2 you are done.

INSIDE THE SERVER: A BALANCING ACT

Silicon "Leakage" increases with Temperature

"Efficient" Over-Cooling can enable Lower power for equivalent workload.

Intel is looking at optimizing balance b/w EPU, Fans, Servers

Finding that now the static CPU's depends more strongly on the temperature

Optimal point is no longer obvious.

WIDER DATA CENTER ENVIRONMENTS

One big modulators is the layout of the server box itself. Want to see moving from "shadowed layout" to a "non-shadowed Layout" cooling memory and cpu gives you highest efficiency.

DATA CENTER POWER MANAGEMENT:

Intel Intelligent Node Manager

Power Monitoring:

-Real-time power consumption of platform = scale voltage and frequency to match workload better.

-Avoid data center hotspots

-Thermal/power scheduling

-Data Center Planning

Increase Rack Density:

-Up to 40% increase in server count per rack

-Maximize Capex ROI for available rack power.

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SERVER EFFICIENCY FOCUS - GLOBAL IMPACT

By 2016:

-number of servers increases 1.5x

-compute capacity grows 9x

-Total server energy consumption stays constant

SUMMARY:

Increased Server Efficiency is "Turning the Tide"

-Growth of Data is Fueling Growth of Data Centers

--Server Energy Consumption is lower

"Gate to Grid" Efficiency Required

-Scaling power consumption to performance is imperative

-Further opportunity in power-optimized components, system design, and data center operation.

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Preparing Your Organization for Global Carbon Issues with High Efficiency Data Centers and Enterprise-Wide Solutions

EATON POWERING BUSINESS WORLDWIDE

Brands that Eaton has acquired over the last several decades: (right side of the slide)

DATA CENTERS - A GLOBAL PERSPECTIVE

Organizations are under social, economic and regulatory pressures to reduce carbon emissions and energy costs globally

Only 3% of the energy entering a data center is used for net computing creating opportunities for efficiency improvements (IBM, 2009)

Enterprise wide IT and Facilities monitoring strategies should be incorporated for regulatory compliance, cost reductions and increase system availability

Proven energy efficient IT, Power Distribution and Power Quality technologies are available to free stranded power from existing facilities and new data centers

KEY: Technology is not the limiting factor, but rather organizational structure and behavior. Your short-term activities are usually in direct conflict with your long term objectives ----> as you move west to east --- east new technology is associated with risk. this is turning and people are realizing technology is enabler to drive business efficiency and no longer the barrier - fundamental business shift

SUSTAINABILITY AND CARBON ISSUES:

Sustainability

- 80% of CEO's view sustainability as impacting brand value
- 31% say they want to rescue their environmental impact
- IT accounts for 2% of the global CO2 emissions, as much as the airline industry

Regulatory

- 82% of executives expect some form of climate change regulation w/in 5 years
- European Union Code of Conduct for Data Centers
- UK Carbon Reduction Commitment (2010)

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GLOBAL CARBON INITIATIVES

USA

- American Clean Energy and Security Act H.R. 2454 passes the House, 6/09 Stalled in the Senate
- Economic situation causes less emphasis
- Green Grid™ metrics and processes

EMEA

- EUEco-Design for Energy using products for servers goes into effect
- Britain's Taxpayer Alliance estimates a family four is paying £800/year
- European Code of Conduct
- UK Carbon Reduction Commitment
- Liaison with The Green Grid

China

- Largest carbon producer
- Serious electricity issues
- Pressure to reduce emissions from global community

Japan

- Energy Conversation Law stipulates conservation standards
- Liaison with The Green Grid

India

- Asia Pacific Partnership on Clean Development (APP)
- US Department of Energy Partnered with US Agency for International Development (USAID)'s ECO-III project
- Local and international data centres

Australia and New Zealand

- Regulatory and voluntary intervention programs
- Energy Efficiency in Government Operation Polity (EEGO) 2006 . Requires government agencies to report annual energy usage and reduction target over 5 years

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IT'S ROLE IN AVAILABILITY AND SUSTAINABILITY

Every entity ties back to IT for guidance.

- IT is uniquely positioned to break-down intra-and inter-organizational silos.
- Gather real-time utility and infrastructure information ($, capacity, incidents…) and proactively manage risk to meet the Line of Business Service Level Agreements and sustainability objectives
- Technology is not the limiting factor, but rather organizational structure and behavior
- Your short-term activities may be in conflict with your long-term objectives

MANAGING CARBON ACROSS THE GLOBAL ENTERPRISE

100 units of coal or gas boil out to 3 units of useful work. There is no downside to becoming more efficient.

A lot of discussion where customers are starting to look at figures and say what do I need a tier 4 data center for.

ENTERPRISE BUSINESS SERVICE MANAGEMENT

- Tie together all the different inputs as it relates to power, units of work getting done, meters, software etc....
- Historically, IT and Facilities operated in silos
- Link the business with IT and Facilities for optimization to improve the overall reliability
- Lower IT operations costs by leveraging IT / Facility software for asset management, event management, business analytics and enterprise monitoring…
- Reporting warehouses for energy and carbon footprint with audit trail

ENTERPRISE MONITORING TECHNOLOGIES:

Eaton is vendor neutral

Don't box people into a corner

IP BASED ENERGY AND POWER QUALITY METERS

- Legacy meters are difficult to integrate into IT and Facilities systems
- Web based like CCTV cameras
- Measure and record Data Centre PUE and DCiE
- Pre-configured Web pages simplifies installation and integration

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STATE OF THE ART LARGE 9395 UPS SYSTEM

- Historically, high availability and high efficiency were conflicting goals
- Highest power performance
  - highest efficiency, lowest THD
  - 99% efficiency across the loading spectrum with Energy Saver System
- Highest reliability & availability
  - Inherent redundancy
  - Concurrent maintenance
- Key traits to specify:
  - Flexible, scalable, upgradeable
  - Lowest weight and smallest footprint
  - scaleable 275 KVA Modules

ACCEPTABLE POWER QUALITY FOR IT EQUIPMENT

- The ITIC curve defines accept tolerances for IT equipment
- The ITIC curve defines
  - % Voltage on Y axis
  - Time on X axis
- Green section on slide is acceptable tolerances

ENERGY SAVE SYSTEM: OPTIMAL PERFORMANCE

What needs to be on and what doesn't need to be on ESS

- User configurable with security passwords
- Maximizing efficiency when utility is within window
- Instantly and seamlessly transitions to double conversion when poor power quality is detected.

NORMAL UTILITY POWER - ENERGY SAVER MODE

- Utilizes "clean" utility power for IT equipment
- Industry leading 99% efficiency
- User configurable tolerances for ITIC (voltage, frequency, modes)

ERRATIC POWER

- Transformer-less designs enables Switches to Double-Conversion in < 2 milliseconds
- User configurable time in Double-Conversion mode to enable utility power to stabilize

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POWER OUTAGE OR SUSTAINED ERRATIC POWER

- UPS draws power from the internal or external battery modules
- Flywheel option
- Generator support for longer-term outages
- User configurable time in Double-Conversion mode to enable utility power to stabilize

ENERGY SAVES EVEN MORE AT LOWER LOADINGS

- ESS Efficiency - 99% across the complete operating range

VARIABLE MODULE MANAGEMENT SYSTEM (VMMS)

- The Facts
  - UPS efficiency vary depending on the % of load
    - Highest efficiency when close to full capacity
  - UPS systems rarely loaded at full capacity
- The Challenge
  - How to maximize efficiency potential of UPS systems with lighter loads

VMMS MAXIMIZING EFFICIENCY WITH LIGHTER LOADS

Solution #1 Manual Loading

- Concentrate the load on certain UPS's to maximize the overall system efficiency
- Some energy savings, not optimal
- Limited to multiple-UPS systems (with several UPS in parallel)

Solution #2 Variable Module Management System

- Automatically optimize efficiency at UPM level
- Concentrate the load on certain UPM's to maximize the overall system efficiency
- Not limited to multiple-UPS systems

Variable Module Management System

- System always in Double Conversion Mode for maximum protection
- Optimally employ UPM's to achieve higher efficiencies
  - When UPM placed into idle mode; Gating stopped in UPM, Input and output contactor remains closed: DC Link is primed (thru diode rectification)
  - Advanced control algorithms allow UPM's immediate return to active double conversion mode (in event of disturbance or load increase on critical bus)

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VARIABLE MODULE MANAGEMENT SYSTEM

- Particularly efficient with multiple-UPM systems for lighter loads
- Drives up system efficiency thus reducing overall energy consumption without compromising reliability

SUMMARY

- Energy costs and regulatory compliance will continue to place organizations at risk
- Organizations should develop proactive strategies to deal with these issues including
  - Enterprise-wide IT and Facilities monitoring
  - Energy efficient IT and Facilities technologies
    - Energy Saver System
    - Variable Module Management System
- Technology is not your limiting factor

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Green Data Designs Trends: Case Study: 2,000,000 SF Critical Facility

LEARNING OBJECTIVES:

- Data Center Design that Supports Sustainability
- Lessons of Data Center Airflow Management
- Synergies of Data Center and Facility Integration
- Energy Modeling Aspects Unique to Data Centers
- Data Center Power Utilization Efficiency Measurement
- Data Center - Air based system = uses outside air to cool it as well as a chiller system
- Supplies very advance rack and server level cooling systems.

NGA CAMPUS EAST

Arm of the Department of Defense.

2.1 million square feet.

11 thousand ton of cooling load.

DESIGN GOALS

- Sustainability – Evolution of Federal Mandates
- Executive Order 12902 – 30% reductions from 1985 energy use
- EPACT 2005 – 30% less regulated energy than ASHRAE 90.1 Baseline
- EPACT 2005 – Increase renewable electricity consumption
- Executive Order 13423 – Benchmarks energy savings against 2003 usages
- EISA 2007 – Across building inventory, reduce energy consumption 30% by 2015 (55,000 BTU/GSF annually)
- EISA 2007 - 55% Energy Usage Reduction by 2010 (New Buildings)
- EISA 2007 - Carbon Neutral by 2030
- Project Target - 30% less regulated energy than ASHRAE 90.1 Baseline
- Integration of Data Center into full Site Sustainability Concept
- 60,000 SF Raised Access Floor – 1,400 server racks – 6.0 kW per cabinet
- 150 WSF Uniform Load Density at the Raised Floor
- Reliability - Tier 2 Facility per TIA Standard 942
- Concurrent Maintainability - Without Dropping Critical Load
- Continuous Cooling
- •Dedicated mechanical "flywheel" UPS

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DESIGN ATTRIBUTES/SYSTEM DRIVE

Technology Center

- High Temperature Differentials
- Dedicated Outside Air Systems
- Split (Medium Grade) Cooling Plant
  - 52 F Supply Cooling Water
  - Water Side Economizer

Office Buildings

- • Alternative HVAC Systems
  - Active Chilled Beams
  - 58F Supply Cooling Water
- 7x24 silo and core areas
  - Critical Cooling
- Chilled water storage
  - Piping length supports 15 minutes
- Ventilation Dehumidification
- Humidity Control
- Air Side Economizer
-

Medium Grade Chilled Water Plant

- Data Center Cooling Equipment Selection Issues
  - Return air - blended 82F
  - Failure Scenarios
  - Unit Selection Parameters
- Chilled Beam Selection Issues and Control Strategies
  - Blended 52F Medium Grade Loop to 58F
  - Return 64F
  - Primary air side cooling – 33%
  - Water side cooling – 67%
- Central Plant Increased Chiller Efficiency
  - 0.447 kW per ton efficiency

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ACTUAL IT DEPLOYMENT

- Densified rack loads
  - 25% of racks 20 kW / rack vs. 6 kW per rack
- Process of Adapting Design
  - CFD Model direct deployment over existing design
  - Airflow Management Solutions
  - Integrate with IT Requirements
  - CFD modeling for design concept verification
    - Back check server inlet temperatures
    - Back check server airflow pressure drop
    - Back check downflow unit selection
- 150 W/SF with 20 kW Server Racks, 52° F CHWS temperature
- Maximum Rack Inlet Temperature Map

SITE ENERGY MODELING

Limitations with Data Center Energy Modeling

- Baseline system is single-zone constant-volume DX system (Exceptions to Standard 90.1 Table G3.1.1 A & B)
  - Fan power budget
  - cooling air temperature difference
- Economizers required for climate zones 1-4A
- No credit for electrical system efficiency
- HVAC water consumption not addressed
- Different operating scenarios not addressed
- Equipment redundancy not addressed

SITE ENERGY MODELING

- 3 Optimize Energy Performance Credits awarded
- Data Center is 70% of receptacle load
- Degrades potential LEED rating

Without data center:

- 30% energy cost savings
- 6 EA c1 LEED points awarded
- Possibly higher level of certification

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Green Data Designs Trends: Case Study: 2,000,000 SF Critical Facility

PROPOSED EFFICIENCY MEASURES:

- Split-temperature variable primary flow CHW plant
- Water-side economizer
- Enthalpy Heat Recovery
- VSD's
- Efficient boilers
- Chilled beams
- Reduced fan power
- Geothermal Heat Pumps (stand alone facilities)

LEED VERSION 2.2 EXAMPLE

Proposed Building Percentage Energy Consumption by End Use

- Receptacles/IT Loads 70%
- Lighting 5%
- Heating 8%
- Base Utilities <1%
- Chilled/Hot Water Pumps 1%
- Fans 6%
- Condenser Water Pumps 2%
- Condenser Fans 2%
- Cooling Compressors 6%

RESULT OF ABOVE

44% regulated energy savings

52% cooling energy savings

41% heating savings

18% energy cost savings

$1.5 MM Annually Savings

Rear Door Rack Heat Exchanger Slide: accommodate up to 20

ROOM SYSTEMS:

using outside air continuously until you get outside the limits. If you need to limit your conditions then its set up to reject hot air to a chilled water system.

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Turn Green into Gold: Sec.179D Energy-Efficient Commercial Building Tax Deduction

GREEN BUILDING HISTORY

- U. S. Green Building Council (USGBC)
- Founded in 1996
- Coalition of leaders from across the building industry who are working to promote buildings that are environmentally responsible, profitable, and healthy places to live and work.
- Breakthroughs in building science, technology and operations are now available to designers, builders, building owners and managers who want to build green and maximize both economic and environmental performance.

GREEN BUILDING HISTORY

Purpose of LEED (Leadership in Energy and Environmental Design):

- Define "Green Building" by establishing a common standard of measurement
- Promote integrated, whole-building design practices
- Recognize environmental leadership in the building industry
- Stimulate green competition
- Raise consumer awareness of green building benefits
- Transform the building market

GREEN BUILDING HISTORY USGBC

Green Building council members developed and continue to refine LEED. The rating system addresses six major areas:

1. Sustainable Sites
2. Water Efficiency
3. Energy and atmosphere
4. Materials and resources
5. Indoor environmental quality
6. Innovation and design process

ANOTHER DRIVER OF GREEN BUILDING

- State and Local Government Committee
- Developed within the U.S. Green Building Council
- Sought to develop a forum for the exchange of information among cities, counties and states to advance the successful implementation of green building programs.
- Local governments can encourage green buildings by mandating green design strategies for their own facilities, as well as providing incentives and guidelines for the private sector.

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GREEN BUILDING BECOMING LAW: SOME CITIES ARE REQUIRING INCLUDING LA

Green Building Today:

- Since 2003: 418% increase in # of cities w/ green building programs
- April 2008: City of Dallas approves Green Building Law
- April 2008: City of Los Angeles approves Green Building law
- DFW metro area: 150 buildings registered with US Green Building Council (USGBC)
- As of March 2007: 53 cities, 11 federal agencies, 17 states, 10 counties have passed Green Building requirements

"I'd say we're adding about five to 10 cities a month."
-Taryn Holowka, spokesperson for the U.S. Green Building Council

BUILDING GREEN: SUSTAINABLE & PROVIDES TAX DEDUCTIONS

What is the Green Building 179D Tax Deduction?

This is about 6 pages.

Energy Policy Act of 05 added section 179D to the Internal Revenue Code

- Energy Policy Act of 2005 added section 179D to the Internal Revenue Code
- Installed as a part of:
  - The interior lighting systems,
  - The heating, cooling, ventilation, hot water systems, or
  - The building envelope
- 50% more efficient as compared to a reference building which meets the minimum requirements of ASHRAE Standard 90.1-2001
- Up to $1.80 per square foot deduction for improving the energy efficiency of your existing commercial buildings or

BUILDING GREEN: SUSTAINABLE & PROVIDES TAX DEDUCTIONS

Definition of Square Footage

- Sum of the floor areas of the conditioned spaces within the building, including basements, mezzanine, and intermediate-floored tiers, and penthouses with headroom height of 7.5 feet or greater.
- Measured from the exterior faces of exterior walls or from the centerline of walls separating buildings, but excludes covered walkways, open roofed-over areas, porches and similar spaces,

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ENERGY-EFFICIENT PROPERTY

Examples of Energy Efficient Property:

- Lighting
  - Energy efficient lighting systems
  - Lighting control system (occupancy sensors/dimmable lighting)
- Envelope
- Energy efficient windows (Low-E)
- Highly reflective roofing
- Enhanced roof and wall insulation

--->Must be conditioned space, one exception is garage.

--->Pentagon: exterior wall to exterior wall not fair must be condition space

ENERGY-EFFICIENT PROPERTY

Examples of Energy Efficient Property:

- HVAC
  - High efficient/heating systems (condensing boilers)
  - High efficient cooling systems
  - Direct and/or indirect evaporative cooling systems
  - Energy recovery units
  - Geothermal heat pumps
  - Premium efficient motors
  - Variable speed fan and pumps
  - Building management systems
  - Solar systems (PV and water)

--->Geo thermal heat pumps 10% credits

--->Solar systems - excluded

PARTIAL DEDUCTIONS: WHAT HAPPENS IF YOU DON'T GET TO THE 50%

If the total annual energy and power costs w/ respect to the combined usage of the buildings heating, cooling & ventilation system and hot water system, the lighting system or the envelope property are decreased by 16 2/3, a partial deduction is available.

The partial deduction is equal to the lesser of $0.60 per square foot or the cost of the installed system.

If two systems each reach the 16 2/3% threshold, the deduction is $1.20 per square foot

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Turn Green into Gold: Sec.179D Energy-Efficient Commercial Building Tax Deduction

PARTIAL QUALIFYING PROPERTY

Interior Lighting (interim rules):

Special partial qualifying rules if installed before the date the Secretary issues final regulations(Notice 2006-52)

- The lesser of $0.60 per square foot or the cost of equipment is available for reductions in light power density (watts-per-square-foot) of 40% or more. The credit is prorated downward for lesser reductions, to as low as $0.30 per square foot for a 25% reduction in lighting
-

Interior lighting (rule requirement)

Must also meet prescriptive requirements

- Have controls
- Include Provisions
- Meet the minimum requirements (cannot put a candle in the corner to say you are efficient)

WHO QUALIFIES FOR THE GREEN BUILDING 179D TAX DEDUCTION

Who Qualifies for the Green Building 179D Tax Deduction?:

- Commercial buildings, constructed or improved, located within the US, placed in service between 1-1-2006 through 12-31-2013
  - If Tenant and Building Owner both paid for improvements, the deduction is split
- Excludes single-family homes and multi-family structures that have three or fewer stories above ground level
- **Important Note:** if the property is government owned the person "primarily responsible" for the design is eligible for the deduction

CERTIFICATION FACTS:

- Must receive certification of energy savings from a qualified individual
  - "Unrelated" professional engineer or contractor licensed in the applicable state
- Must use Dept. of Energy approved modeling software
- Software compares actual building to reference building
  - Located in the same climate zone and otherwise comparable to the taxpayer's building except that it's interior lighting, heating, cooling, ventilation and hot water systems and building envelope meet the minimum requirements of Standard 90.1-2001

REQUIRED CONTENTS OF CERTIFICATION OF ENERGY SAVINGS:

- Name, address, and telephone number of qualified individual
- Address of the building
- A statement that the relevant energy and power costs reduction requirements are met
- A statement that the reduction has been determined under the rules of Notice 2006-52/2008-40
- A statement that field inspections of the building have confirmed that it has met or will meet the relevant

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energy-savings targets and that the inspections were performed in accordance with the proper procedures.

- A statement that the building owner has received an explanation of the energy-efficiency features of the building and its projected annual energy savings
- A statement that qualified computer software was used to calculate energy and power consumption and costs, and identification of the software
- A list identifying the components of the interior light systems; heating, cooling, ventilation and hot water systems, and building envelope installed on or in the building; the energy-efficient features of the building; and its project annual energy costs.
- A perjury statement

SOURCECORP PRE-ENGAGEMENT PROCESS

Our Green Building Study Process/Overview:

- Preliminary review of the construction drawings and specifications under the interim rules
- Determine building qualifications
- Provide deduction and benefit to CPA/client free of charge
- Once engaged, energy modeling will be performed
- Professional engineer performs energy modeling and analysis
- Site visit performed
- Engineer follows the NREL (National Renewable Energy Laboratory) standard guides and checklists to verify that the property meets the energy savings targets and gathers any additional information not included in the plans
- Use industry-standard cost estimation techniques to determine the cost of the qualifying energy efficient property
- Finalize the section 179D study and provide an overview of the energy saving features

ENGAGEMENT PROCESS

Audit Support

- 40 hours of audit support provided
- As necessary, file a Form 8821 to be able to discuss the study with the agent
- For additional audit support, we can file a Form 2848 and work with you on providing the best audit defense for your client

In Conjunction with a Cost Segregation Study:

- The basis is reduced by the amount of the deduction
- The cost of the energy efficient property is determined to establish the amount of the deduction

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On The Tax Return

- Current Year:
  - Current year deduction reduces basis in property
  - Deduction is shown as "Other Expense" on tax return
- Previous Year:
  - Previous returns need to be amended

Key points to remember:

- LEED vs. 179D
- Requirements to achieve 179D deduction
- Benefits of 179D deduction
- Certification

---> Makes sense for large buildings - not that valuable for those that are not. For government buildings this doesn't work but the deduction can be assigned to the designer of the government building.

---> How do you apply for this? get allocation form that protects the IRS from auditing everyone who thinks they are entitled. Person primarily responsible for design. Can't be all three designers, only 1 can apply.

John Killey
Head of Realty Services, EMEA
Citibank

CASE STUDY: The World's First Platinum LEED Certified Data Center - Citi in Frankfurt

THE CHALLENGE:

To deliver a "state of the art" data centre providing 100k SF white space with a design load of 1000 W/m2 (scaleable to 1500 w/m2), inside 24 months (site time 12 months)

To ensure the data centre achieves the following key design requirements of:

- Reliability
- Performance
- Cost Optimization
- Energy efficiency
- Minimizing the environmental impact
- To achieve greater than Tier IV reliability (> 99.995% availability).
- To be recognized as providing a facility that minimizes its environmental impact throughout its life.

DRIVEN BY CITI'S GLOBAL ENVIRONMENTAL COMMITMENT

Commitment to reduce Citi's absolute greenhouse gas emissions by 10% from our 2005 baseline by 2011
With more than 85 million SF of Real Estate this equates to over 130,000 tonnes of CO2.

THE APPROACH

- KEY: to embed sustainability into all of the projects core activities.
- To consider sustainability in all design decisions and its interaction with reliability, performance and cost.
- KEY: To incorporate sustainability into the procurement process.
- KEY: To ensure early engagement of all stakeholders, end users, managers, delivers of project, partners.
- To foster close co-operation between stakeholders
- To utilize LEED Accreditation to support and recognize the integrated sustainable design and construction approach (achieving a minimum Silver rating).
- To obtain ISO14001 once in operation for continuous environmental performance improvement.

LEED was very important in terms of support and recognition it gave them. They have a standard.

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WHY LEED AND ISO 14001?

LEED (Leadership in Energy and Environmental Design) an accepted benchmark for a buildings energy and environmental impact during:

- Design
- Construction
- Operation

Provides an immediate tool for measuring and comparing the environmental impact performance.

Promotes a whole building approach to sustainability looking at 5 key areas of human and environmental health:

- Sustainable site development
- Water savings
- Energy Efficiency
- Material selection
- Indoor environmental quality

ISO14001 promotes continuous environmental improvement.

KEY: embodies a lot of things we need to do.

14001 LEED EB as a process to continue to improve.

AT CONCEPT DESIGN

Decided to go one step further.

Senior management commitment from:

- Client
- Designers
- Contractors

Environmental requirements embodied in:

- Consultant Briefing Documentation
- Design Documentation
- Procurement Documentation

...and formed part of contract documentation and selection criteria. Collaboration was key during construction and commissioning phase

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THE SOLUTION - THROUGH PROCUREMENT

Along with performance, cost and reliability, sustainability was an equal design consideration for:

- site selection
- for systems and materials selection.
- for construction process and management.
- on going operation

and resulted in:

- Use of low environmental impact materials.
- Consideration of embodied energy of construction materials and their benefit as environmental modifiers.
- Minimization and reuse of excavated materials on site.
- Minimization of site waste and maximization of on-site recycling.
- Water efficiency and rainwater salvage.
- Site planting, "garden zones" & the vegetation of external facades.

Senior management commitment from:

- Client,
- Designers,
- Contractors (most often forgotten but we need their commitment)

Environmental requirements embodied in:

- Consultant Briefing documentation,
- Design documentation,
- Procurement Documentation

Most key thing: Collaboration. During design and construction phases. As went through phases they realized silver was achievable and then gold.

THE SOLUTION - THROUGH DESIGN DECISIONS

Green Roof and Green Wall – Supporting sustainability, performance, reliability and cost efficiency by:

- Creating biodiversity lost in the construction
- Increasing roof life/reliability – waterproof membrane life increased to 40 years
- Reducing rain water run off with reduced construction, sewer/storage costs
- Benefiting the ecology through rainwater attenuation and re-use
- Converts CO2 to O2.

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Materials Selection – Supporting sustainability, performance, reliability and cost efficiency by:

- External shading (brise soleil) constructed from zero maintenance timber from sustainable sources with 1/3 less embodied CO2 over Aluminum
- External aluminum panel screening with high recycled content
- High use of locally extracted/produced building materials to reduce cost and transportation CO2 emissions.

Along w/ performance, cost and reliability, sustainability was an equal design consideration for: site selection, for systems and materials selection, for construction process and management, on going operation

and resulted in:

use of low environmental impact materials

THE SOLUTION -THROUGH DESIGN DECISIONS SLIDE:

Systems selections – Supporting sustainability, performance, reliability and cost efficiency by:

Water Systems

- Reverse Osmosis water treatment plant incorporating blow down Recycling
- Higher reliability with reduced water– saving 11.6MM US galls p.a./ €217m p.a.
- Reduces environmental impact through lower chemical and CO2 emissions
- Capturing up to 90% of rainwater for reuse on site.
-

Cooling systems

- High internal air temperature.
- CRAC supply: 20°C (5-7°C higher than a typical data centre)
- CRAC return: 27-29°C (5-7°C higher than a typical data centre)
- High chilled water temperature.
- Flow: 10°C (3°C higher than a typical data centre)
- Return: 18°C (6°C higher than a typical data centre)

THE SOLUTION -THROUGH DESIGN DECISIONS

Green Roof and Green Wall: Supporting sustainability

Why have a green roof: makes a statement, creates co2, when you look at roofs and the way they fail - don't want a leaking roof. By putting material over the top you protect it. UV degradation protected by this. Also, acts as a buffer from rain.

Materials Selection - Supporting sustainability, performance, reliability and cost efficiency by:

- External shading- MIssing
- External aluminum - Missing
- High use of locally - Missing

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Systems selections - Supporting sustainability, performance, reliability and cost efficiency by:

Raised Floor Air Management Systems

- Perforated baffles in front of CRAC convert velocity into an even static pressure – reduced fan power, reduced electricity, reduced cost.
- High velocity jets and recirculation under the active floor area are eliminated – improved cooling performance.
- Variable speed drive fans automatically maintain the even pressure in the event of CRAC failure. – increased reliability, reduced energy reduced cost.

Above floor airflow management

- Open network frames are interleaved with server racks to reduce length of data cabling - reduced copper, reduced cost.
- All data cabling is at high level to eliminate cable dams and data cable penetrations, - reduced static pressure, reduced fan power, reduced electrical cost.
- Novel Hot-Aisle/Cold-Aisle/Cold-Aisle layout overcomes typical problems with open frames - improved cooling performance, increased resilience, reduced cooling costs.

THE SOLUTION - THROUGH CONTRACTOR ENGAGEMENT

Contractor Involvement

- LEED® language in each specification section
- LEED® Pre-Construction Manual
- Pre-Bid Meetings
- Post/Award Meetings
- Subcontractor Orientation
-

The Contractors role in specific LEED® Credits

- Erosion and Sedimentation Control Plan
- Commissioning Coordination
- Construction Waste Management
- Performance-based Material and Resource Selection
- Construction IAQ Management
- Low Emitting Material Management

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CASE STUDY: The World's First Platinum LEED Certified Data Center - Citi in Frankfurt

WHAT DOES THIS ALL GIVE US?

Optimized Cooling design:	Enhanced free cooling of 63%, COP of 11% by using VSDs, all primary pumps with VSDS
Enhanced CRAC unit design:	Power consumption reduced from 9.3 kW to 3.3 kW per Unit
Advanced Cooling tower design:	Power consumption reduced from 74 kW to 22kW per Cooling tower by using High efficiency CT with single fan on top; fans speed controlled by VSDs
All pumps with VSD:	Consequent use of VSDs for all pumps to allow running pumps on their designed operation point
Usage of Rotary UPSs	Power loss reduction via UPS from 9% to 2%
Light Control:	Light controlled by presence
Heat recovery system:	Usage of high efficiency heat recovery systems in all fresh air systems
Advanced water treatment design:	Cooling tower bleed recovery combined with water storage facilities and reverse osmosis plant.

Full load power consumption of a typical Data Centre- PUE = 1.58

Full Load power consumption CG Data Centre – PUE 1.2

CONCLUSION

Sound environmental design does make business sense

Can only be achieved by embedding the concepts of sustainability within the design, construction and operations processes.

Will only be achieved through a collaborative, integrated design and construction process.

Must start with the initial project planning and run through the whole building life cycle.

Can enhance, not compromise, the key criteria of reliability, performance and cost effectiveness.

Bruce Myatt PE
Klinstubbins

Steve Robert
Billhighway.com

Jim Garrity
Hosting.com

PANEL: The Corner Office: Perspectives from CTO, the CIO, the Middle-Front Office

From a corner office perspective: competing factors----> continuing to build data space so trying to find ways to make sure they have the right architects, the right plan, being good consumers of space and electricity. Then make sure being cost effective. Hosting.com builds cloud clusters that are fully managed. Everyones services remain online. Tie in data center model and trying to find a way to stay highly available.

Audience Question: Greatest achievement that might be like Citi's platinum

Billhighway.com: went out to industry to figure out what techniques allowed for growth. Invested a lot of internal resources to create an infinite growth model platform.

Hosting.com: was actually developing cloud architecture and instrumentation around it. He built a data center ever year he was there. They couldn't sustain their growth and the operational headaches that went along wtih 5k, 6k, 10k servers. Going to lose hard drives, fails are going to happen. Became difficult to support the growth over time. They wanted to sink more money into optimizing.

Citi: Greatest achievement is actually having the sustainable in the agenda at all. Sustainability wasn't an important issue but now its on the agenda and its being seen as a top priority.

Who makes corporate decisions:

Citi comes from the top. citi was one of the first to make the commitment they have. 10% reduction in green house gas. Their commitment was that they wanted to cut by10% and they are doing that. Becomes part of operating criteria that they are judged by.

How many services can you deliver for a given amount of energy. Do you have any sense how efficiency or product delivered improved per the environmental commitment.

Hosting.com Cloud early adopters, in business 2.5 years. amount of services they can provide from Cloud perspective - can consolidate whole rack of services into two machines in a cloud. More density every time there are new processors.

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PANEL: The Corner Office: Perspectives from CTO, the CIO, the Middle-Front Office

Risk Management: how do they measure and identify opportunities of value to bring into operations:

Steve: We listen to our customers and put a lot of value on the customer experience. Identify if they can do things that are suggested by customers. When things get up higher in priority they introduce it to Trail Blazer Team and every quarter they challenge them to create new and innovative ideas.

Jim: They have engineering team that's always working on newest things to see if they add value to the company. Organic team process. Will never see COO or CMO come down and say do this or that.

2006-2007 great transformation in processors and the power they consumer. Went to 2 year depreciation b/c taking up tremendous amount of power. Also standardized on Intel and replaced a lot of gear in their facility. It has dropped their power utilization significantly. 144k a month to 80k a month power bill per month. Big savings.

Approach Partnerships & Projects by: Steve Start with clear and candid, honest and transparent. As they ID the job they use a score card and review with vendors weekly. Track whats truly important. Not important gets weeded out. As engagement goes on they do a retrospective - vendor, clients, internal meeting of the minds talking about what worked well & what didn't. Intent is to identify things that didn't work. Things will go wrong but ID them and taking 1 or 2 from every engagement will improve. CLEAR, Candid, Honest Communication.

How to you communicate with the public:

Jim: All comes back to making sure mission and value statements all align with that directive. Mission: provide cost effective, scaleable, redundant and clean service. Everyone in the company knows that mission and every project has that mission in line. If goals don't align with this

Steve: Similar to zappos. Every customer touch point is an opportunity for engagement. Everyone is a marketer.

Daniel Golding
Managing Director
DH Capital, LLC

Tesh Durvasula
QTS

Third Party Server and Storage Datacenters DH Capital. Third Party Server/Storage Colocation: Finding "Green" in Extreme Efficiency

WHO ARE YOU?

Daniel Golding, Managing Director, DH Capital

DH Capital is a boutique investment bank which services internet infrastructure firms, such as Hosting and Colocation/Datacenter

WHY ARE YOU LISTENING TO A BANKER TELL YOU ABOUT DATA CENTERS?

BS, Mechanical engineering, Auburn University

MS, Telecommunications, George Mason University

Navy Nuclear Power

12 years experience in Network

WHAT IS A THIRD PARTY DATACENTER?

Retail or Wholesale Colocation/Datacenter Leasing

Retail Colocation - buy cabinets/cage - around 10/12 years

- 1-5 year K for cabinets or cages
- Up to 2k sq ft or 400kw
- Full Service - remote hands, sometimes managed services

Wholesale Datacenter - Very new

- 3-15 year triple-N leases for space/power
- 1MW and greater
- Lesser array of services - "bring your own" You staff it yourself to some degree.

Some fusions of the two models, but providers typically have different structure - corporate (colo)vs. Real Estate Investment Trust (wholesale)

REIT can't give you a lot of services

All about taxes and how they are valued

WHO'S WHO?

Wholesale Datacenter	Retail Colocation
Digital Realty Trust	Cervalis
DuPont Fabros Technology	Savvis
Quality	Verizon
Coresite	Equinix

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CHARACTERISTICS OF THIRD PARTY DATACENTERS

More than just Ping and Power

- Typically high quality
  - Particularly post-2000 constructions
  - High redundancy/high quality
  - Not seeing tier 4
- Highly power efficient as compared to enterprise datat centers
  - Profitability often turns on efficiency - this is why it is the way it is.
- Highly reliable with little down time
- Can be carrier operated on carrier-neutral
- Use of carrier-neutral providers is highly encouraged
  - Once upon a time it was carriers but these days vast majority are carrier neutral and he suggests not to go with carriers.

WHO USES THIRD PARTY DATA CENTERS?

Not Who You Think:

Once upon a time....

- Companies that sell dog food over the internet-then fail
- 2000-2001 was a bad time for these businesses

2005 and after

- Very little "dotcom" revenue
- Primarily telecom carriers, mid-sized and large enterprises, financials, content providers, gaming/entertainment, software-as-a-service
- Shared characteristic: downtime can cause business failure

WHY DONT YOU BUILD YOUR OWN?

Isn't owning your own datacenter, better?

- No, almost never
  - Smaller data centers cost more on a unit basis (smaller square foot and power) cost more to build and way less efficient.
- Enterprise data centers tend to be less reliable and more expensive
  - Network services cost more
  - Staff is not as well trained
- This isn't a typical outsource solution -"my mess for less"
  - Better service, cheaper, but different - opex instead of capex
- Disaster recovery means a multiple datacenter strategy
  - "Own one, rent one"

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WHAT GOES INTO COLO/WHOLESALE?

It isn't the same mix as enterprise data centers

- Typically higher I/O and network performance requirements
- Servers are typically more utilized - economics predicate behavior - less free riding. If you are paying you will pay attention, put procedures in place.
- Higher bandwidth applications
- Internet and transport bandwidth is far less expensive
- More Storage
- Strong movement towards storage in colo/wholesale over recent years
- Storage is exploding
- Not full of blade servers -1U server is predominate server platform - 6kw cabinets average up to 15k

WHAT ABOUT ALL THE GREEN STUFF?

Its not the same Green You are thinking about

- Datacenter providers have certain costs
  - Capex is construction and sometimes servers
  - Opex is people and power
- Power cost reduction is the key to profitability in the datacenter business
- The more efficiently you run your datacenter, the higher your profit margin
  - This is true, even when power is passed through
- Result - Datacenter operators will spend more on CapEx to lower PUE - 1.6 is average, with some in the 1.3 range

WHAT ABOUT ALL THIS GREEN STUFF?

Good Thoughts Are Wonderful

- But, it isn't easy being green.
  - Informal poling shows that datacenter users are unwilling to pay more for green data centers in US
  - Only marginally willing to pay more in Europe
  - Claims of devotion fall away when it comes time to negotiate
- Only economics can produce desired behaviors
  - Datacenter provider industry has economics uniquely aligned to green priorities, without any government regulation
- What about Carbon taxes?
  - A wash for most datacenter operators - regulatory costs passed through.

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Third Party Server and Storage Datacenters DH Capital. Third Party Server/Storage Colocation: Finding "Green" in Extreme Efficiency

INTERVIEW: A REAL, LIVE, DATACENTER OPERATOR

Tesh Dervasula:

If you're not building 10 mega watts don't bother. Biggest struggle is that CTO says I need this stuff now CIO says yes I see that coming and CFO says do you know how much that costs.

Move stuff to where it costs less.

Sherman Ikemoto
GM

The Model Data Center: Operational Management of Data Centers Through Simulation

TRICK: **Address bypass and circulation or mixing of air then all the benefits trickle down through the cooling system.**

The Impact of Bypass:

- Wasted fan energy
- Lower return air temp
- Generally lower heat exchange performance
- "lost" cooling capacity

Energy is saved in fan power. Fan power is driven by IT equipment airflow requirement. A 50% reduction in airflow reduces fan power by 8x. Same thing goes for your chiller as well.

KEY: Airflow management

What is at Stake?

- Operational cost overruns
- IT equipment reliability: reduce life span of unit by reducing temp.
- Data Center lifespan

Airflow Management Strategy:

Supply air to the cold aisles; hope that it reaches the IT equipment - this is usually static. The actual technology hasn't changed must over the past two years.

BUT, IT equipment has change significantly. Been about 13 generations of IT technology over the years.

There is no standard so it mixes the air dramatically.

Hot isle contain all hot air properly. But at 2007-2011 three generations of IT equipment had a break down the hot air isle containment significantly.

Airflow Management Summary

- Airflow management is fundamental to realizing the full potential of the data center
- A fixed facility design cannot cope with a rapidly evolving IT landscape

Key aspect of this simulation = integrated with data center infrastructure management. Can be used by IT operations. Breakthrough.

Stores about every piece of data.

Steven Robert
CIO
Billhighway.com

Head in the Clouds: Cloud Computing and Grid Technology

DEFINE CLOUD COMPUTING:

- Platform or "service" accessed over a network to provide advanced, often transparent functionality for mass consumption and high-availability.
- Seasonal or as-needed utilization is a classic use case.
- Evolutionary: years ago it was called ASP but as you became sophisticated it started to referred to as software as a service. The cloud builds on all these characteristics.

GENERALLY ACCEPTED

- Self-Service- don't need large engagements or consulting to asses. Barrier here is that its accessible to everyone regardless to what project or what stage you are at.
- Delivered over the network
- Elastic scalability (grow as big as you need, pay as you go...)this lowers the barrier of entry. As the need increases you can just turn the virtual dial up and most platforms allow for seemless transition.

Key is ---> Think of it as renting IT resources vs. buying

BILLHIGHWAY.COM

- 98% Domestic (increasing interest abroad)
- 291,540 customers (and counting..)
- $5 million in financial transactions PER DAY
- > $4 billion processed to date
- > 5 million Pageviews/month
- Sustained 5-year annual growth of 70%
-

Some Challenges We Face

Young company with a lot of potential. Lots of things occurring in their systems causing bottle necks. New techniques emerging that ultimately led up to the cloud.

- Customer base growing exponentially
- Limited resources (budget, staff, & time)
- Compounding system complexity
- Increasing scrutiny around financial integrity, compliance & regulations
- System performance suffered

Solutions We Found

- "Service" Oriented Architecture (SOA)
- Service Broker – asynchronous messaging
- Rules Engine – layers of abstraction --> be able to deliver to those who understood this.

Steven Robert
CIO
Billhighway.com

Head in the Clouds: Cloud Computing and Grid Technology

- GRID Computing – distributed computing
- Virtualization – HA, DR & Scale
- Storage Area Networks - iSCSI

----> Discovered the cloud out of necessity.

CLOUD -> BUSINESS TRANSLATION

- Consider the cloud a technical utility.
- Understand your risk tolerance and current business stage to establish a threshold for use.
- Stages of a business*:
- Stage 1: Existence (Speed to Market)
- Stage 2: Survival (Competitive Differentiation)
- Stage 3: Growth (Core Competency)
- Stage 4: Take-Off (R&D)

GROWTH PHASES:

Phase 1 a lot of opportunity to leverage. Need to take your idea, with small set of resources, and get that idea up and running in an extremely expedient way.

Phase 2 is about polishing. Depending on your platform from stage 1 you may be able to build on it. Looking at process efficiency. There are cloud providers that can help with specific needs here

Phase 3: growing and maturing. Look at what you've done and ask yourself, what type of business are you in? Is what you're doing sustainable?

Phase 4: Mature product and here the interesting way of looking at this: maintaining today while building for tomorrow.

Phase 5: Every organization is not maximizing if they don't have a presence in vendor ecosystems.

TECHNICAL FLAVORS

- Infrastructure Platforms (pain vs. opportunity) -- example would be amazon. they do a great job when you really need to scale. if you have seasonal cycles, intuit uses them.
- Development Platforms (creation & delivery)-- example Microsoft as your platform. Can look at new opportunities on WindowsAzure. You can just dial up capacity. Built with infinite scalability.
- Business App Platforms (exposure) -- Salesforce.com You can bring your product to their market place for special needs.
- Special Purpose/Social & Mobile Platforms: (consumer/viral) -- LinkedIn, Myspace, Ning --successful communities with millions of users looking to standardize. Cost effective way to get product in front of millions of users

Steven Robert
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Head in the Clouds: Cloud Computing and Grid Technology

WHO ARE THE PROVIDERS?

- "Cloud Computing will be as influential as E-Business" ~ Gartner Research
- Cloud Computing market may reach $160BN by 2012 ~ Merrill Lynch
- anyone with internet space to either gain or use

SPOTLIGHT: FINANCIAL INSTITUTIONS

- Mine masses of data for business value
- Private vs. Public cloud offerings
- Ideal future for infrastructure lifecycle upgrades
- MoSes – Risk & Financial Modeling Software
    - Asset Price Generator
    - Multi-Segment Corporate Modeling

WHY CONSIDER THE CLOUD?

- IT Budgets have not kept pace with growing business needs
- Managing data growth & extracting value = major challenges
- Lack of scalability & capacity
- Firms are ill-equipped to handle infrastructure growth needs

SOUNDS GREAT – RIGHT?

- Microsoft Azure - March 2009, ~22 hours
- RackSpace - June 2009, ~ 24 hours
- Salesforce.com – January 2010, > 1 hour
- Amazon – Numerous 2009-2010, ~ hours ea.
- Intuit – June 2010, ~ 2 days

Cloud <> Perfect

- Early Adopter vs. Reliability?
- Transparency is Key!

Key is being transparent. When there is an outage, tweet, blog about it. Be accountable and transparent every time. People want to know and they will talk about it and if you don't give them a constructive environment to do so that can be damaging.

Steven Robert
CIO
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Head in the Clouds: Cloud Computing and Grid Technology

CLOUD TRAJECTORY

- Enhanced Virtualization (DR, HA & Security)
- Intelligent Workload Management (IWM)
- Data Storage as a Service; Peering
- No SQL key-Value Stores
- Hybrid Clouds
- PaaS – to integrate private/public clouds

DO YOUR HOMEWORK!

PRO's

- Reduced costs
- Resource sharing is more efficient
- Management moves to cloud provider
- Consumption based cost
- Speed to market
- Dynamic allocation

CON's

- Compliance/Regulation laws mandate on-site ownership of data
- Security & Privacy
- Latency & Bandwidth guarantees
- Absence of robust SLAs
- Portability & lock-in
- Availability & reliability

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Dense High Performance Computing in Small Spaces

TODAY'S LIMITATIONS

Power density of full rack= 700W/Sq ft

400W/server x 42 = 16.8KW

Rack footprint = 24 sq ft

Solution1: Under populate rack, very wide aisles

Long network runs, poor performance

Waste of space

Solution 2: Heroic air systems

Affordability

Cooling power

AIR COOLING IS ENERGY INTENSIVE - WHAT IS AIR DOING FOR YOU?

An extra 50% to 100% of IT load used for cooling

If we were rational people we wouldn't use it. Physically it has tremendously low specific heat and it costs a lot of money to drive enough air to the spaces you need to drive the energy.

Actually have to add energy to things you are trying to take energy away from - its a waste.

...is too complex for small spaces (air)

very complex engineering effort and extremely expensive

AIR SHADOWS AND THROTTLES

- Downstream CPU gets heated air
- Hottest CPU determines max speed
- Inherent enclosure air flow limitations
  - Constrains power
  - Limits over clocking
  - DIMM problems

A NEW COOLING ARCHITECTURE

- Each server is cooled by an individual cold plate
  - Cold plates and insertion mechanism is designed for use of standard 1U servers
  - Circulating refrigerant is the cooling medium
- Highly flexible cold plate
- Backed with pressure plate
- Forms to server lid
  - Compensates for lack of server coplanarity

Dense High Performance Computing in Small Spaces

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SUN X4100 SERVER CONVERSION

- Fans and heatsinks removed, replaced with heat risers.
- Lid treated with Super Compliant TIM

CHILL OFF RACK

- 36 1U server slots with cold plate cooling
- 40kW cooling capacity per rack
  - 45U x 800mm (w) x 1200mm (d).
  - 3 1U standard non cooled slots
    - for switches, etc.
- Rack sold by Liebert, Inc
- Model name: XDS rack
- Connects via standard Liebert XD refrigerant connections to XDP pumping unit
- Cold plates supplied by Clustered & installed in Liebert rack

ENERGY CONSUMPTION COMPARISONS

Tests have shown that they can use up to 35 degree coolant in the system
Annual Power Cost is more expensive with air cooled 1U vs. Liquid Cooled 1U servers.
Will cut by about 50% using servers cooled with contact.

OTHER BENEFITS

- Compelling return on investment
- No added cost and complexity
- No specially trained personnel
- No additional support costs
- No liquid in the enclosure
- No reliability impact of 1000's of quick connects
- No residual air circulation required
- Noiseless

SUMMARY

- Fulfills requirements for conventional HPC as well as high frequency trading
- Lower TCO
  - Energy, Space, Capex
- Performance and reliability improvement
  - No shadowing as in air cooled servers
- Put it anywhere
  - Noiseless, no complex ducting, only plumbing

Scott Carr
Managing Director
DataPod

A Modular Approach to Data Center Facilities

ABOUT DATAPOD:

- A Canberra based company established in 2007 to fill a gap in the Australian market for expert data centre engineering solutions.
- Started life as Data Centre Consultant providing electrical engineering, mechanical engineering and planning services.
- Datapod has designed and deployed data centres across broad range of verticals
  1. Defense -- big customers of theirs
  2. Federal Government
  3. University Education
  4. Mining
  5. Finance
- Developed award winning data centre system 'Datapods', patent pending. Working on further R&D with the Australian National University

ENGINEERING CAPABILITIES

Datapod focused on data centre engineering excellence.

Datapod has developed a patent pending infrastructure containment system. Integrates technology from APC by Schneider Electric.

Datapod supplies standardized Datapod Solution as also provides custom engineering solutions.

"Get to drive before you buy"

MANUFACTURING CAPABILITY

Datapod has a production capacity of 10,000 Datapod containers per year.

Datapod pre-packages APC by Schneider Electric technology.

Datapod provides custom contract manufacturing services.

FIELD SERVICE CAPABILITY

Australia's No.1 System Integrator of APC Hot Aisle Containment systems 2010.

Datapod provides a comprehensive suite of field services.

- Site Assessment Services
- Site Preparation Services
- Datapod Installation Services
- Electrical Installation Services
- Mechanical Installation Services
- Preventative Maintenance Services
- Project Management Services

Scott Carr
Managing Director
DataPod

A Modular Approach to Data Center Facilities

Key takeaway: only 1% of fuel energy burnt at generator actually makes it to the computer. If we can get energy efficiencies in the data center we have a cascading effect.

consuming lots of resources and there is a lot to do to move to a more sustainable space.

TOWARDS SUSTAINABILITY

- Sustainability Drivers
  - Energy Cost Savings
  - Regulatory Drivers
    - Carbon Tax / Cap & Trade
    - Government Incentives
- Sustainable Energy Sources
  - Renewal Energy Contracts
  - Onsite Energy Source
  - Embedded Energy and Recycling
- Improve Energy Efficiency
  - Applications Layer
  - IT Infrastructure
  - Facilities/Site Infrastructure

THE MODULAR APPROACH

- The modular approach leads to data centre facilities that can be manufactured, factory assembled and tested.
  - Assembly line efficiencies that significantly reduce build costs and embodied energy consumption.
  - Facility procurement models identical to IT procurement model, including flexible lease arrangements.
  - Factory assembly, testing and quality assurance
  - All steel facilities that can be recycled at end of life
  - Incremental deployment on demand

Right Sizing: take a smaller approach and build it up from end to end with components that are designed to work at optimized capacity.

MONITORING AND CONTROL

Standard Modular Facilities simplify the integration of monitoring and control.

- UPS monitoring for performance and alarms
- InRow cooling units monitored for performance and alarms
- Stationary Power Distribution Units monitored
- Rack PDU are monitored for power consumption and each of the outlets are remotely controllable.
- Environmental Monitoring Units are deployed in each Datapod unit.

Scott Carr
Managing Director
DataPod

A Modular Approach to Data Center Facilities

- Netbotz™ camera pods monitor activity throughout the data hall.
- Chiller plant and pumps monitored for performance and alarms

SCALABLE INCREMENTAL INVESTMENT

- Scenario: a customer requires 400-kW of incremental IT capacity annually for the next five years for a total of 2-MW IT capacity.
  - Typical Data Centre Construction: $30 million to build a 2-MW facility that would operate at only 16 percent in the first year and gradually work up to 80 percent in the fifth year.
  - Incremental Deployment: 400-kW IT capacity per year for five years will run at 80 percent utilization every year (higher efficiency) and will have nearly $18 million left over thanks to the lower net price and interest

THE UTILITYPOD

- Packaged chillers, backup generators and main switchboards which can connect directly into expandable data-pod. Aggregates all site services by connection node.

FEATURES OF DATAPOD:

- Able to employ leading class technologies from APC
- Purpose Built Environment
- Complete Site Infrastructure Services Portfolio
- IT Vendor Neutral
- IT Load up to 33kW per Rack

Jon Flower
Principal,
Technology Office
PMC-Sierra

CASE STUDY: Going Green by Improving Architectural Balance in Servers and Storage

ARCHITECTURE OF A COMPUTER

This hasn't changed much in the past 10 years

- WAN
- Network Adapter
- CPU
- Motherboard
- Memory
- Storage Controller

WHY IS BALANCE IMPORTANT?

Key Opportunity = most applications you see today are massively over provisional when it comes to CPU. Customers are coming back and saying we want to buy something that fits us better --- this is a crisis for Intel. Would be better to have Storage, Networking and Memory go faster and catch up with CPU

The Architecture is "balanced" when this part of each resource is in use

A certain amount of these resources will not be utilized because of bottlenecks in the slower components

Energy provided to power and cool under-utilized components is wasted

KEY: Balance all the parts

HOW OUT OF SYNC ARE THINGS?

CPU Power:

- Circa 1995: 1 socket, 1 core, 500MHz
- Circa 2010: 4 sockets, 8 cores, 3GHz
- Net multiplier: ~200x

Storage I/O

- Circa 1995: Seek time: ~20ms
- Circa 2010: Seek time: 3ms – 15ms
- Net multiplier ~2x – 7x

SOLID STATE DISKS TO THE RESCUE

Proposition:

- Combine rotating and solid state disks to balance cost per GB and performance?
- Can we do this in a way that applications can use?

Hardware Seek Time: Rotating Drives 3ms -15ms Solid State Disks: <0.05ms

Operation per second per device: Rotating Drives 100-300 Solid State Disks >30,000

Retail Cost/GB: Rotating Drives $0.05 Solid State Disks: $20-$50

We got the 100x operation count back, but we lost out big time on the $/GB

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CASE STUDY: Going Green by Improving Architectural Balance in Servers and Storage

HYBRID STORAGE AND "HOT SPOTS"

- Operates transparently with ANY application
- Application sees the capacity that it used to see
- Access to "hot" data occurs at SSD speeds

Trying to divide up the applications in the world and characterize which ones will actually work.

Solving for a Total Processing Rate

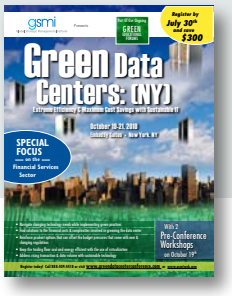
New system is balanced and process 4x as much work load as the old ones.

TRADITIONAL

- 20 Servers
- CapEx Cost: $294,000*
- 4yr Power + A/C Cost: $121,000**
- 1 complete rack

SSD ENABLED METHOD

- 6 Servers + 24 SSDs
- CapEx Cost: $110,000*
- 4yr Power + A/C Cost: $35,000**
- 1 rack, with remaining space



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