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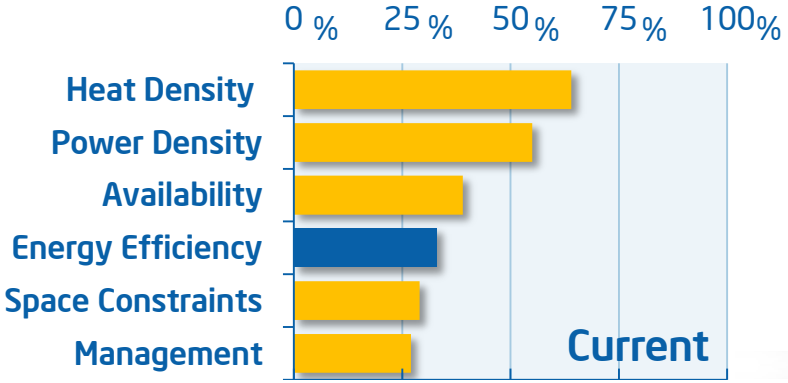
Energy Efficiency and Power Management

Gaining More From Less

intel Software Products

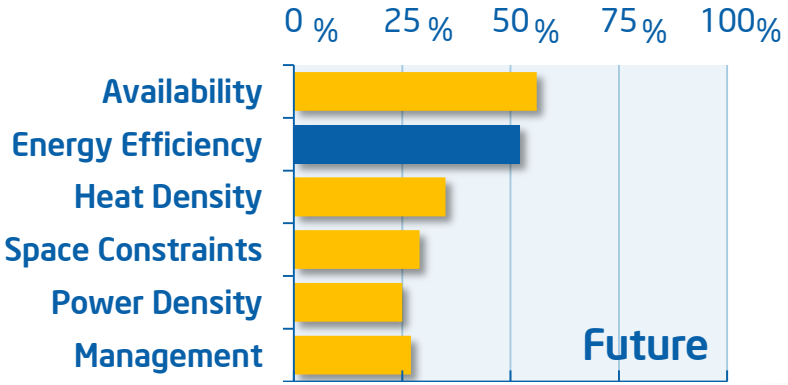
Energy Efficiency in the Data Center
How to Gain More from Less

Top Facility Concerns



"Energy costs are the fastest-rising cost element in the data center"

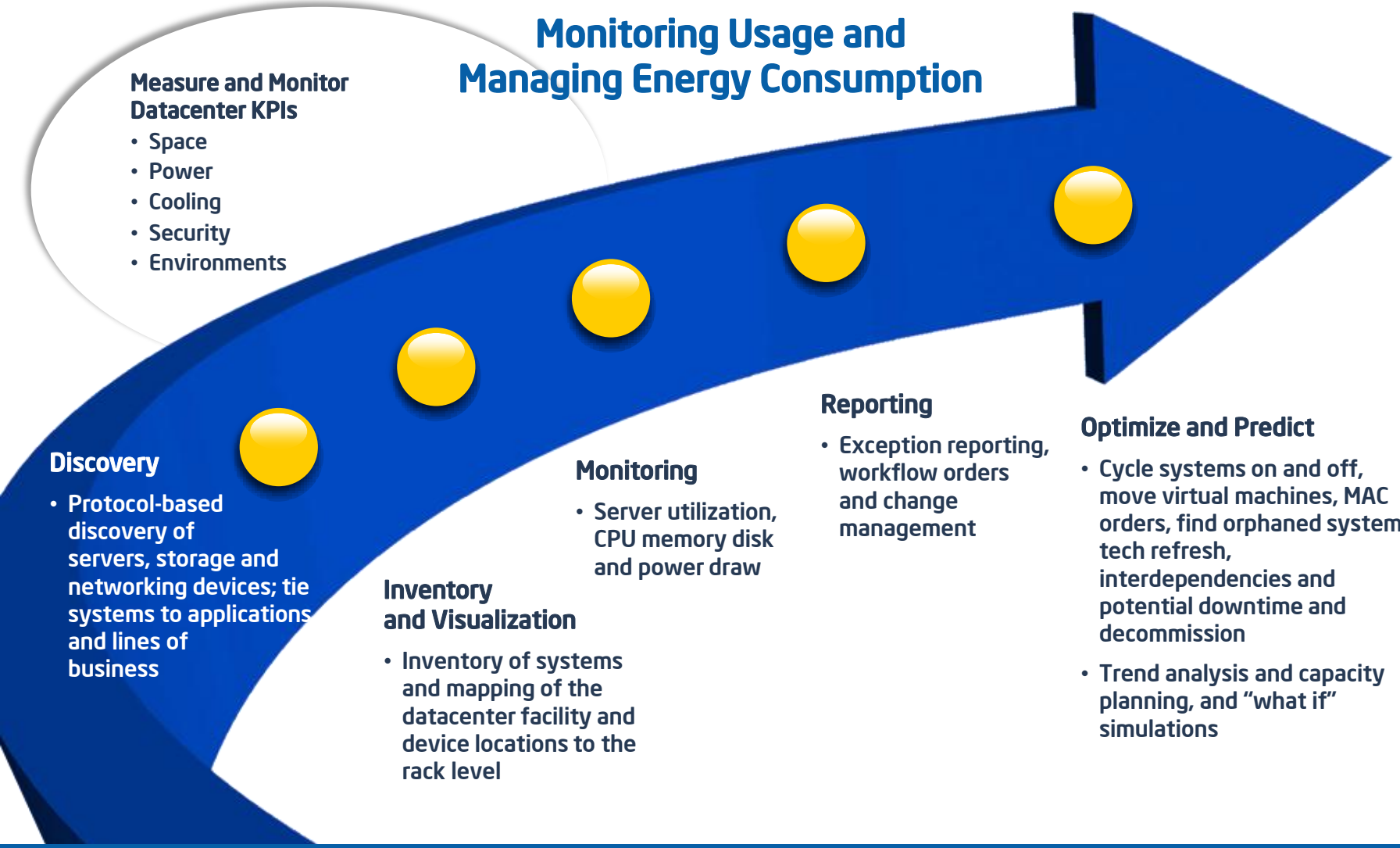
Gartner



"Data centers are capacity constrained and new data centers require multi-million $ investments"

IT Ops Manager

The Ramp Up to Energy Savings



Source: IDC, 2010

Power Management in Datacenters

Management Console

GAP

- Multi vendor/protocol
- Low level communication
- Scaling
- Security
- Group power management expertise
- Usage model implementation
- TTM new platform capabilities

Rack Servers

Blade Servers

PDU & UPS

Intel® Data Center Manager (DCM)

A middleware with Web Service APIs for Datacenter Power and Thermal Management; Easy to Integrate in the Management Console

ISV Management Console

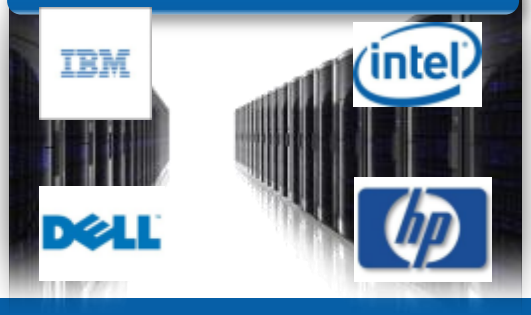
DCM Middleware (Web Service API)

- MONITOR
- CONTROL
- TREND
- SCALABILITY
- STANDARDS

Hardware Protocols

Node Manager IPMI	iDRAC IPMI	iLO/DCMI IPMI	IMM IPMI	CMC HTTPS/WS-MAN	OA SSH/CLI	IMM SSH/CLI	SNMP

Rack Servers



Blade Servers

PDU and UPS

DCM Product Features (2.1 – 2.5)

Device Support :

- Support DCMI 1.0 Power Mgmt Interface
- Managing IBM Enclosure & Blade (AMM)
  - Average power monitoring (AMM)
- Managing HP Enclosure & Blade (OA)
  - Instantaneous power monitoring on enclosure
  - Temperature monitoring on blade
  - Or ISV may choose DCMI interface for blade power monitoring
- Extended PDU support to Avocent PM 2000/3000 and ServerTech Smart PDU
- Cisco DCMI rack server (power monitoring)
- RHEL 6.x support

Feature Enhancements :

- Two-tier architecture for scalability support (up to 10K nodes)
- Fail-over, solution provisioning and virtualization support for two-tier architecture
- Power policy efficiency improvements
- Group power on/off under user defined power constraint
- Power capping recommendation
- Device inventory pre-scan using IP ranges
- User Custom info field – for user defined data
- Node Power Limit – shows current power policy value on nodes
- Estimated server idle – based on historical trends

DCM Support Across Various Devices

	Node Manager enabled servers (Like Dell 6100, 1100, 2100)	Dell 11G Server	HP Server*	HP BladeSystem Enclosure	IBM server (X series)	IBM BladeCenter Chassis	Facility Device (UPS, PDU)
Power monitor	Yes	Yes	Yes	Yes, instantaneous (enclosure level only)	Yes, Instantaneous	Yes	Yes, Instantaneous
Power control	Yes	Yes (only for rack servers)	Yes**	No	No	No	No
Thermal monitor	Yes	Yes	Yes	No	Yes	No	No
Protocol	IPMI	iDRAC	DCMI (iLO)	CLI (OA)	IPMI (IMM)	CLI (AMM)	SNMP
Availability	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Best Case

Subject to change without notice

* iLO update might be required
** Requires Advanced iLO License

Data Center Manager Delivers

- Power and Thermal Monitoring
- Increased Rack Density
- Workload Power Optimization
- Business Continuity

Software and Services Group

DCM Value Drivers – DC's

#	Value Driver	Actual	Estimated
1.	**Measure energy usage by device**: Provides clients ability to baseline, monitor, analyze and manage energy consumption across the enterprise (a factor towards refresh)	100% Accurate	Not always accurate
2.	Assists power **capacity planning** by providing actual data on energy consumption (increase rack density) – real time data available	Accurate all the way to device level so can drive better capacity planning	Not always accurate
3.	**Proactively** Identify Failure situations by monitoring events around Power and Thermal (hot spots, CRAH failures)	Need real time monitoring	No real time monitoring
4.	**Energy Efficiency**: Improve thermal profile of DC (avoid overcooling and undercooling of DC)	Real time thermal monitoring	No thermal estimations
5.	**Identify dead servers**: Servers that are consuming power but running no workloads	Real time power monitoring	Can be driven if monitoring CPU utilization
6.	Pinpoint **under-utilized servers** and low-density servers consuming the most energy (prime candidates for virtualization)	Real time power monitoring	Can be driven if monitoring CPU utilization
7.	**Business Continuity**: Identify Failure situations early by monitoring and events around Power and Thermal (hot spots, CRAH failures)	Real time power and thermal monitoring	Not possible
8.	Power optimization/control	Real time connection and control	Not possible

DCM value and ROI

#	Value Driver	Existing Infrastructure & Problems	ROI Value
1.	**Measure energy usage by device:** Provides clients ability to baseline, monitor, analyze and manage energy consumption across the enterprise	1. Most DCs estimate thermals and power 2. No visibility into power usage by device 3. 15% ghost servers in Enterprise 4. Demonstrate the energy optimization during refresh	Leading DCs moving towards real-time monitoring Identify and remove abandoned servers • Free up critical slots in racks • One company saved $500/server/yr**
2.	**Increase Energy Efficiency** Improve thermal profile of DC (avoid overcooling and undercooling of DC)	1. Most data centers operate within wide bands of cooling ranges because they estimate thermals 2. Server level spikes in power and heat are often symptoms of failing fans and power supplies	Increase Preventative Maintenance To avoid under-cooling or over-cooling servers Intel DCM can optimize chiller settings. • $50K/year savings for each degree of temperature increase*
3.	**Assist Capacity Planning** Providing actual (not estimated) data on energy consumption (increase rack density) – real time data available	1. Most often they are built on estimates of current workloads 2. Racks are only 60% filled because DC operators do not know exactly how much power the servers in the racks are using	Determine true power consumption Trend power over day, week, and yearly peaks and valleys (i.e. show seasonality) Intel DCM PoCs and deployments shows up to 30% increase in rack density**

* "Data center managers can save 4 percent in energy costs for every degree of upward change in the set point." (Sun Microsystems)
http://www.datacenterknowledge.com/archives/2008/10/14/google-raise-your-data-center-temperature; Assuming average DC consumes $1.25M in energy/year.

** Based on the Baidu Intelligent Power Optimization for Higher Server Density Racks whitepaper on the http://datacentermanager.intel.com website

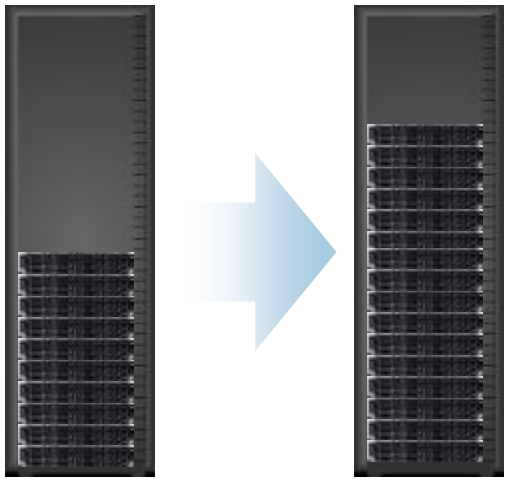
Usage Example 1 Rack Provisioning/Capacity Planning

Provision rack with 4 KW available power

Goal:
Fit as many servers as possible within 4 KW envelope

Traditional method: static provisioning

- 650 watt power supply rating
- Use 400 watts as safe bet from lab measurements for expected configuration
- Install 4,000 KW/400 watt per server = 10 servers



Before After

Baidu had increased rack density from 8 to 9 servers per rack, ~$490 per server savings with no performance impact

*Calculations are based on lab measurements and typical specifications of dual-socket servers provisioned with Intel® Xeon® 5500 or 5600-series processors. Results may vary depending on actual conditions.

Real time monitoring with power budget enforcement*

- Actual measurements indicates power/server rarely exceeds 250 watts
- Use 250 watts as aggressive power/server budget
- Enforce 4 KW global cap for rare cases where demand would exceed 4 KW
- Install 4,000 KW/250 watt per server = 16 servers
- Payoff: increase rack loading by 60 percent

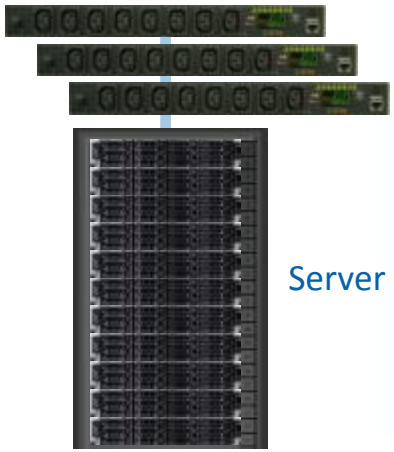
Usage Example 2 Intelligent Power Strip Replacement

DCs use intelligent power strips for power monitoring

- High cost
- Reduce complexity of separate infrastructure, cabling, etc.
- May still require additional software from PDU vendor

Before

Intelligent power strips



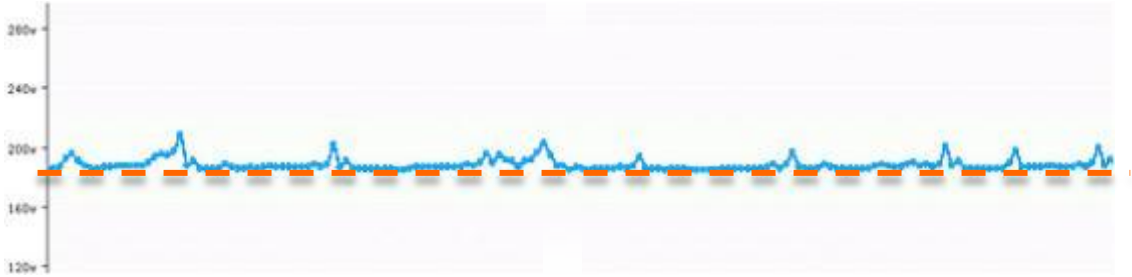
After

Usage Example 3 Identify Dead/Under Utilized Servers

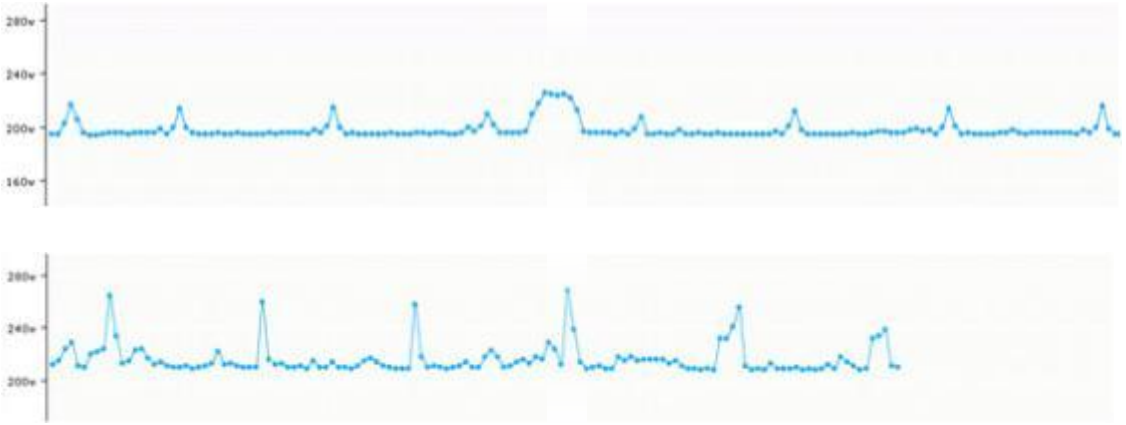
Servers are consuming power but not doing anything useful

It is estimated that 10–15% of data center servers are “ghost servers”

Some servers consume idle ~70% of the time, most likely under-utilized



For some servers workload is cyclic. Some are busy evening (18:00-20:00) while other are busy mornings (7:00-9:00). Potential for consolidation.



Usage Example 4 Disaster Avoidance Under Impaired Conditions

Data centers environment

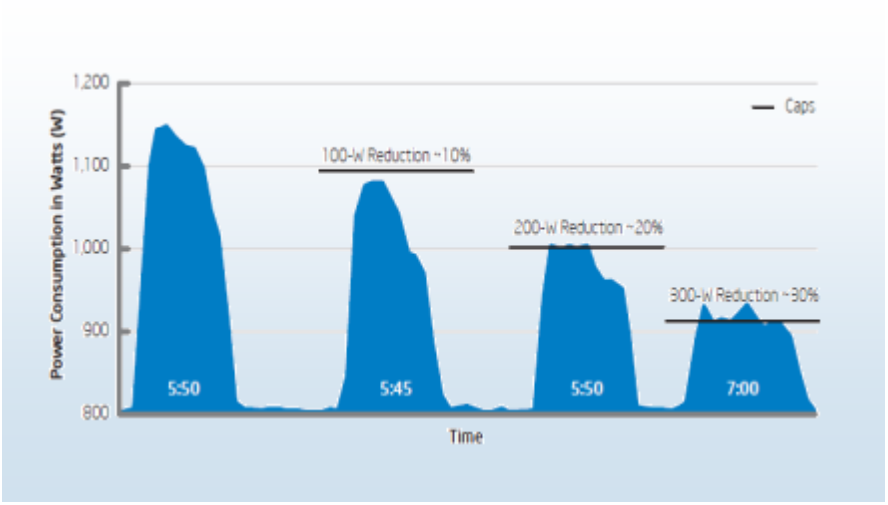
- Hours of work lost if unscheduled shutdown happens

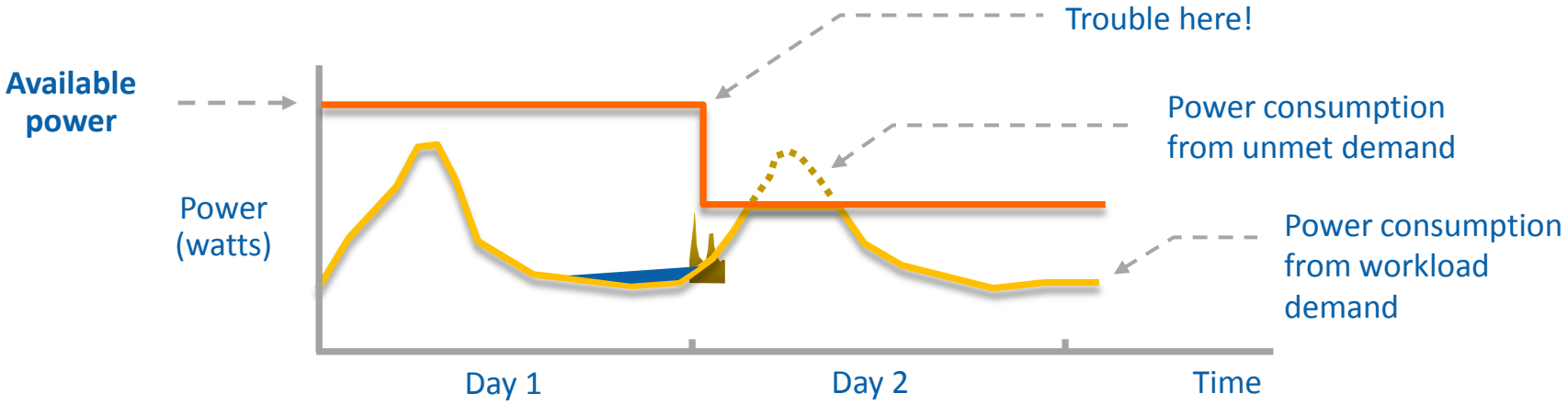
Power monitoring capability

- Real time assessment of power margins

Power capacking capability

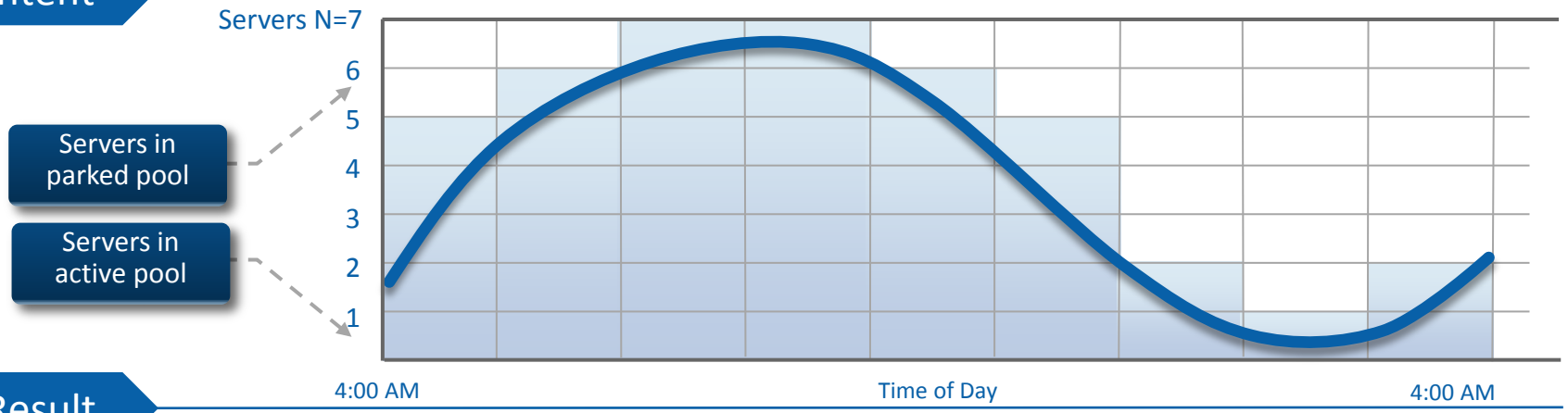
- Budget power for continued operation
- Prioritize power allocation to servers



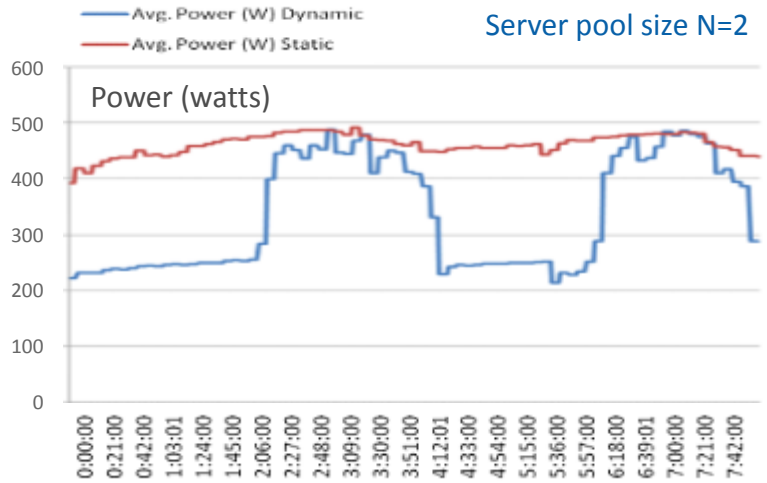


Usage Example 5 Equipment Scheduling to Meet Workload Demand

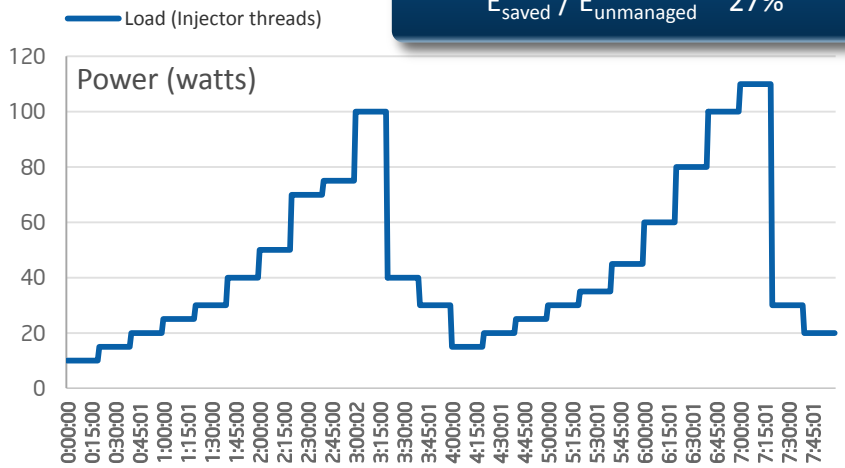
Intent



Result

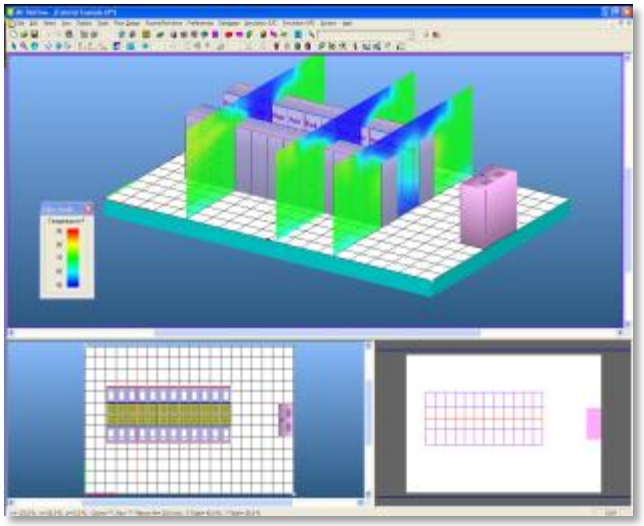


Energy savings attained:
$E_{saved} / E_{unmanaged}$ ~ 27%



Usage Example 6 Build Real-Time Thermal Maps

- Thermal sensors in server platforms enable building real-time thermal maps in the data center
- Proactively identify failure situations by monitoring events around power and thermal (hot spots, CRAH failures)
- Improve thermal profile of DC (avoid overcooling and undercooling of DC)



DCM Go to Market

DCM enabled via ISV

- DCM is embedded in ISV solution and transparent to customer
- Customer buys power management solution directly from the ISV

DCM enabled via OEM

- Educate customer IT team on OEM product versions that support monitoring via DCM

DCM direct via Customer developed solution

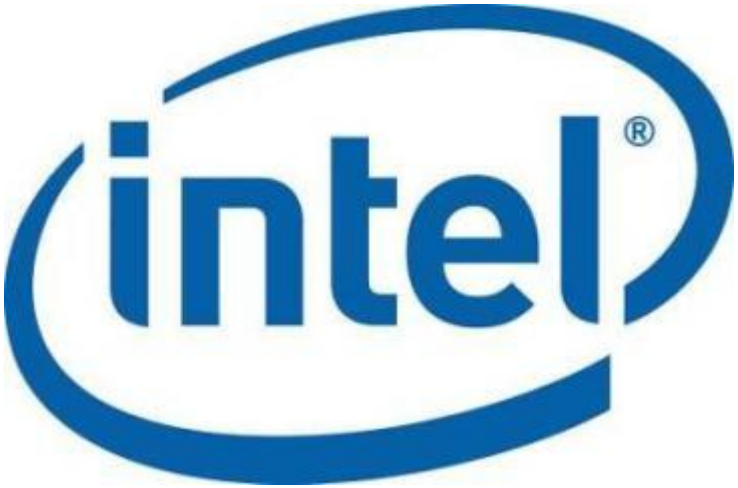
- DCM can be integrated to home grown console with minimal investment from customer
- Intel licenses DCM to the customer and provides support

DCM Deployment options in End user

Let's Get Started

- Whitepapers and Examples on Website
- Contact dcm-sales@intel.com to Setup a Trial and Understand Licensing Options

www.datacentermanager.intel.com



Thank You