Energy Management for IBM zEnterprise™ 196

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agenda

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<th></th>
</tr>
</thead>
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Goals for energy management

Cost Reduction and Avoidance

- Identify opportunities for energy cost reduction (Operating Expenses)
  - Reduce Over Provisioning
- Delay facility expansion due to energy or cooling constraints (Capital Expenses)

Remove Operational Barriers

- Manage power and cooling capacity to enable growth and flexibility
  - Power Control (Capping, Power Saving)
- Avoid service disruptions caused by energy related outages
  - Identification and reaction to Energy Fault Events

Manage Risk and Streamline Compliance

- Document and validate energy efficiency gains to stakeholders
System z Energy Efficiency Roadmap

2007 z9
- Power Calculator
- Mainframe Gas Gauge
- Published typical energy numbers

2008 z10
- Advanced power & thermal trending via Active Energy Manager
- Power-savings mode for unused and idle processors

2010 zEnterprise
- No growth in power and thermal footprint
- Added altitude & temp sensors to reduce fan power
- Enhanced power savings for unused and idle processors
- Overhead cabling option
- HV DC input power option
- Water Cooled option
- Add reporting of humidity & heat load to water vs. air
- Static Power Savings mode
- Query Max Potential Power
- Energy Management part of Unified Resource Manager

A. Bieswanger / B. Kostenko
z196 Water Cooling Option

- Water cooled cold plate on processor MCM in each processor book
- 2N Water Conditioning Unit (WCU) with independent chilled water connections
- One WCU can support system
- Heat Exchanger (HX) removes heat from exhaust air at back of both frames
- Typically ~70% of system heat load is removed to water.
- Air cooling back-up mode for maximum robustness (all heat load to air if lose chilled water in to WCU’s)

Diagram:

- Internal, closed, conditioned water loop
- Chilled water flow is function of heat load on WCU & chilled water temp.
- Not to scale, not physically representative

Data Center Chilled Water

2N building chilled water lines will have better RAS – single facility supply/return shown here.
zEnterprise Water Cooling Option

- Reduce max air heat load to less than 10 kW (about 5 kW typical)
- Input energy saving 2 kW
- Additional power saving in data center typically about 3 kW (water cooling efficiency higher than air cooling efficiency)
z196 Capacity per Watt improvements

<table>
<thead>
<tr>
<th>15 years of CMOS: G2 to z196 *</th>
<th>Net Effect: G2 to z196 *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Increase: 17% per year</td>
<td>Performance increased by: ~300x</td>
</tr>
<tr>
<td>Performance increase: 46% per year</td>
<td>Performance / kWatt increased by: ~30x</td>
</tr>
<tr>
<td>Power density increase: 13% per year</td>
<td>Performance / sq ft increased by: ~190x</td>
</tr>
</tbody>
</table>

Note: Capacity/kWatt assumes hot room, max plugged I/O power, max memory power and all engines turned on. Real world max capacity system is about 3/4 of this.

Note: z196 data is not final, numbers are best available as of 7/22/2010.
Static Power Saving Mode

- **Main use cases**
  - Periods of low utilization
  - CBU Systems: Systems used for disaster recovery

- **Base mechanism**
  - Build upon existing RAS functions (frequency/voltage variation) implemented originally for MRU failures (since z900)
  - Use frequency and voltage reduction to reduce energy consumption of CEC
  - Only explicitly triggered by customer. No autonomic changes done “under the cover”

- **Power Savings Mode expectations**
  - Frequency reduction: ~ 17%
  - Processor voltage reduction: ~ 9% voltage reduction
  - Expected system power savings: ~ 10%-20% power savings (configuration dependent)

- For air-cooled systems entering power save is limited to once a day.

- Update to “STSI: SYSIB 1.2.1 (Basic-Machine CPU) Performance-Reduction Indicator” to reflect entering and leaving power save mode
Max Potential Power

- **Main use cases**
  - Allows reducing power allocation for system since you know the maximum power system can draw even with faults and hot room
  - Allows facility and system people without knowledge of z system configuration and use details to query max possible power of system
  - Looks like power capping to higher level management tools

- **Base mechanism:** Calculation of max potential power based on
  - System configuration
  - Altitude (absolute pressure sensors in bulk power subsystem)
  - Hot room environment
  - Highest single fault service scenario power condition for this configuration
  - Reasonable tolerances

- **Max Potential Power should be used in conjunction with the System z Power Estimation Tool which allows pre-planning for power and cooling needs**
Optimize Power/Cooling Allocation with Max Potential Power

Label Power

Max Potential Power

Power (watts)

Time →

← Trending (weeks, months) →

Allocation Model of Server

Wasted Power / Cooling Allocation

Over Allocated Power not converted into compute cycles

Proper Power/ Cooling Allocation

Power budget converted into compute cycles

Power typically allocated to a server
zEnterprise with zBX (z Blade Extension)

IBM Blades

Optimizers

x86

Power

Blade Virtualization

Blade Virtualization

Z HW Resources

Support Element

System z Host

zOS

zTPF

z/VSE

Linux

Linux

z/VM

System z PR/SM

System z Hardware Management Console (z/HMC) with Unified Resource Manager

BladeCenter

CPC

zCPC

Blade

Blade

B

B

B

B

zBX - Optional Factory Packaged Application Serving Blades and Accelerators

Private Management Network

Ensemble Management Firmware
... value made possible by the Unified Resource Manager

- Simplified installation of hypervisors
- Gain significant time to market with improved speed of deployment
- Save time, cost and simplify asset management
- Decrease problem determination and resolution time for cross-platform resources
- Improve and simplify cross-platform availability procedures
- Enable broader and more granular view of resource consumption
- Factory installed and configured network
- Improved network security with lower latency, less complexity, no encryption/decryption
- Insight into energy consumption and environmental data
- Integrated energy management
- Energy cost savings
- Allow critical workloads to receive resources and priority based on goal-oriented policies established by business requirements
- Smart business adjustments based on workload insight
- Provide deep insight into how IT resources are being used
- Gain flexibility, consistency and uniformity of virtualization
- Provide the business with faster time to market
- Simplified network management for applications

Hypervisors
Energy
Operations
Performance
Virtual Servers
Networks
zEnterprise Energy Management Structure

Enterprise Management

- Active Energy Manager
- IBM Director
- Other apps (e.g., Capacity Provisioning Manager)

Hardware Management Console

Support Element

Energy Management

- GUI
- API

Power Sub-system Controller

System z server

BladeCenter AMM

Active Energy Manager

HMC/SE Energy Monitoring Dashboard

GUI

API

Energy Management

Hair: active energy manager

IBM Director

Other apps (e.g., Capacity Provisioning Manager)

GUI

zEnterprise 196

Support Element

Power Sub-system Controller

System z server

AMM
Energy Monitoring Overview

Monitoring data available at

- Main HMC UI
- Monitors Dashboard
- Environmental Efficiency Statistics
- More detailed data for shown for
  - **Blade**,
    - Energy and environmental data
    - Active energy controls
  - **BladeCenter**
    - Aggregated energy and environmental data
    - Active energy controls
  - **zCPC**
    - Energy and environmental data
    - Active energy controls
    - Max potential power
  - **CPC**
    - Aggregated energy and environmental data
    - Active energy controls
  - **Ensemble**
    - Aggregated energy data
Energy Information at the Main HMC UI

<table>
<thead>
<tr>
<th>Select</th>
<th>Name</th>
<th>Status</th>
<th>Power Usage</th>
<th>Machine Type/Model</th>
<th>Serial Number</th>
<th>Location</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C.2.01</td>
<td>Operating</td>
<td>168 840671Y</td>
<td>Z800</td>
<td>YL10/0150096</td>
<td>C01B6001</td>
<td>POWER Blade</td>
</tr>
<tr>
<td></td>
<td>C.2.02</td>
<td>Warning, Definition error</td>
<td>158 840671Y</td>
<td>Z800</td>
<td>YL10/0150096</td>
<td>C01B602</td>
<td>POWER Blade</td>
</tr>
<tr>
<td></td>
<td>C.2.04</td>
<td>Warning, Operating</td>
<td>155 840671Y</td>
<td>Z800</td>
<td>YL10/01470AF</td>
<td>C01B604</td>
<td>POWER Blade</td>
</tr>
<tr>
<td></td>
<td>C.2.05</td>
<td>Warning, Operating</td>
<td>157 840671Y</td>
<td>Z800</td>
<td>YL10/014707X</td>
<td>C01B605</td>
<td>POWER Blade</td>
</tr>
<tr>
<td></td>
<td>C.2.06</td>
<td>Warning, Operating</td>
<td>157 840671Y</td>
<td>Z800</td>
<td>YL10/0147064</td>
<td>C01B606</td>
<td>POWER Blade</td>
</tr>
<tr>
<td></td>
<td>C.2.07</td>
<td>Warning, Operating</td>
<td>163 840671Y</td>
<td>Z800</td>
<td>YL10/014709X</td>
<td>C01B607</td>
<td>POWER Blade</td>
</tr>
<tr>
<td></td>
<td>C.2.08</td>
<td>Warning, Operating</td>
<td>155 840671Y</td>
<td>Z800</td>
<td>YL10/014708A</td>
<td>C01B608</td>
<td>POWER Blade</td>
</tr>
<tr>
<td></td>
<td>C.2.09</td>
<td>Warning, No Power</td>
<td>9 7773.32X</td>
<td>Z800</td>
<td>YL12/09231030</td>
<td>C01B609</td>
<td>POWER Blade</td>
</tr>
<tr>
<td></td>
<td>C.2.10</td>
<td>Warning, Operating</td>
<td>153 840671Y</td>
<td>Z800</td>
<td>YL10/0147077</td>
<td>C01B6010</td>
<td>POWER Blade</td>
</tr>
<tr>
<td></td>
<td>C.2.11</td>
<td>Warning, Operating</td>
<td>153 840671Y</td>
<td>Z800</td>
<td>YL10/0147077</td>
<td>C01B6010</td>
<td>POWER Blade</td>
</tr>
</tbody>
</table>

Tasks: P000R97
- CPC Details
- Toggle Lock
- Daily
- Recovery

- Service
- Change Management
- Remote Customization
- Operational Customization
- Object Definition
- Configuration
- Energy Management
  - Set Power Cap
  - Set Power Saving
- Monitor
  - Customize Activity Profiles
  - Environmental Efficiency Statistics
  - Monitors Dashboard

Max Page Size: 5000
Environmental Efficiency Statistics

<table>
<thead>
<tr>
<th>Date and Time</th>
<th>Power Consumption (kW)</th>
<th>Power Consumption (Blk/hr)</th>
<th>Temperature (°C)</th>
<th>Temperature (°F)</th>
<th>OP Utilization (%)</th>
<th>Blade CPU Utilization (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul 13, 2010 12:00:00 AM</td>
<td>13.957</td>
<td>47657</td>
<td>20.0</td>
<td>78.8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jul 13, 2010 1:00:00 AM</td>
<td>14.133</td>
<td>48224</td>
<td>28.0</td>
<td>82.4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jul 13, 2010 2:00:00 AM</td>
<td>14.025</td>
<td>47856</td>
<td>26.0</td>
<td>78.8</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Jul 13, 2010 3:00:00 AM</td>
<td>14.036</td>
<td>47803</td>
<td>26.0</td>
<td>78.8</td>
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<td>0</td>
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<td>13.985</td>
<td>47719</td>
<td>25.0</td>
<td>77.6</td>
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<tr>
<td>Jul 13, 2010 5:00:00 AM</td>
<td>13.989</td>
<td>47732</td>
<td>26.0</td>
<td>78.8</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Chart Content: Power Consumption (kW)
Energy Management Information - CPC and zCPC

### CPC
- **Power rating:** 42884 W
- **Power consumption:** 10371 W
- **Power saving:** Not supported
- **Power capping:** Not supported
- **Cap range:**
- **Current cap:**

### zCPC
- **Power rating:** 33440 W
- **Power consumption:** 7563 W
- **Ambient temperature:** 31.5°C (88.7°F)
- **Exhaust temperature:** 41.0°C (105.8°F)
- **Humidity:** 27%
- **Dew point:** 10.7°C (51.3°F)
- **Heat load (forced-air):** 25825 BTU/hr.
- **Heat load (water):** 0 BTU/hr.
- **Maximum potential power:** 8393 W
- **Maximum potential heat load:** 28638 BTU/hr
- **Power saving:** Not supported
- **Power capping:**
- **Cap range:** 8393 W - 33440 W
- **Current cap:**

---

**Note:** The image includes a screenshot of a HMC (Host Management Console) interface displaying the energy management information for CPC and zCPC.
Energy Management Information - BladeCenter and Blade

<table>
<thead>
<tr>
<th>Instance Information</th>
<th>Acceptable Status</th>
<th>Product Information</th>
<th>Energy Management Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power rating: 9444 W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power consumption: 1302 W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature: 24.5°C (76.1°F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhaust temperature: 32.0°C (89.6°F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power saving: High Performance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power capping: CUSTOM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cap range: 2820 W - 9444 W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current cap: 9444 W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power usage: 1302 W</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B.1.02 Details - B.1.02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance Information</td>
</tr>
<tr>
<td>Power rating: 382 W</td>
</tr>
<tr>
<td>Power consumption: 164 W</td>
</tr>
<tr>
<td>Power saving: High performance</td>
</tr>
<tr>
<td>Power capping: Disabled</td>
</tr>
<tr>
<td>Cap range: 277 W - 382 W</td>
</tr>
<tr>
<td>Current cap: 382 W</td>
</tr>
<tr>
<td>Power usage: 164 W</td>
</tr>
</tbody>
</table>
Energy Management Information - Ensemble

Energy Management Information - Ensemble Details - Alpha Ensemble

- Energy Management Information
  - Power rating: 85768 W
  - Power consumption: 5158 W

OK  Apply  Cancel  Help
Energy Controls Overview

- **zCPC**
  - Power Save

- **Blade**
  - Blade power save for all blades supporting power savings mode
  - Blade power cap

- **BladeCenter**
  - BladeCenter group power save
    Ensure that all elements in a group (that support it) are in power save or high performance state.
  - BladeCenter group power cap
    Ensures that the group power consumption stays at or below the maximum value specified in the group cap using automatic power budget distribution.

- **CPC**
  - CPC group power save
  - CPC group power cap
Set Power Saving Task

![Set Power Saving Task Image]

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Power Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>CINTSE01</td>
<td>Defined CPC</td>
<td>Custom</td>
</tr>
<tr>
<td>zCPC</td>
<td>zCPC</td>
<td>Low Power</td>
</tr>
<tr>
<td>B.1</td>
<td>BladeCenter</td>
<td>High Performance</td>
</tr>
<tr>
<td>B.1.01</td>
<td>System x Blade</td>
<td>High Performance</td>
</tr>
<tr>
<td>B.1.02</td>
<td>System x Blade</td>
<td>High Performance</td>
</tr>
<tr>
<td>B.1.03</td>
<td>System x Blade</td>
<td>High Performance</td>
</tr>
<tr>
<td>B.1.04</td>
<td>System x Blade</td>
<td>High Performance</td>
</tr>
<tr>
<td>B.1.05</td>
<td>System x Blade</td>
<td>High Performance</td>
</tr>
<tr>
<td>B.1.06</td>
<td>System x Blade</td>
<td>High Performance</td>
</tr>
<tr>
<td>B.1.07</td>
<td>System x Blade</td>
<td>High Performance</td>
</tr>
<tr>
<td>B.1.08</td>
<td>System x Blade</td>
<td>High Performance</td>
</tr>
<tr>
<td>B.1.09</td>
<td>System x Blade</td>
<td>High Performance</td>
</tr>
<tr>
<td>B.1.10</td>
<td>System x Blade</td>
<td>High Performance</td>
</tr>
</tbody>
</table>

Total: 62  Filtered: 62
Energy Management Automation

Set up a Scheduled Operation - P0000R97

The following scheduled operation will be created:

Set power saving

Select the date and time of the initial execution, then select a time window.

Date and Time
Date: 8/2/10
Time: 3:42 AM

Time Window
- 10 minutes
- 20 minutes
- 30 minutes
- 40 minutes
- 50 minutes
- 60 minutes

Set Power Saving

Name  Type  Power Saving
P0000R97  CPC  Custom
zCPC  zCPC  High Performance
C.2  BladeCenter  Custom
C.2.01  Blade  High Performance
C.2.02  Blade  High Performance
C.2.04  Blade  High Performance
C.2.05  Blade  High Performance
C.2.06  Blade  High Performance
C.2.07  Blade  High Performance
C.2.08  Blade  High Performance
C.2.09  Blade  High Performance
C.2.10  Blade  High Performance
C.2.11  Blade  High Performance

Total: 13  Filtered: 13
### Set Power Cap

#### Table

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Power Capping</th>
<th>Cap Value (Watts)</th>
<th>Cap Value Range (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0000R97</td>
<td>CPC</td>
<td>Disabled</td>
<td>115050</td>
<td>7402-115050</td>
</tr>
<tr>
<td>zCPC</td>
<td>zCPC</td>
<td>Disabled</td>
<td>33440</td>
<td>8393 - 33440</td>
</tr>
<tr>
<td>C.2</td>
<td>BladeCenter</td>
<td>Disabled</td>
<td>9444</td>
<td>6114-9444</td>
</tr>
<tr>
<td>C.2.05</td>
<td>Blade</td>
<td>Disabled</td>
<td>382</td>
<td>277-382</td>
</tr>
<tr>
<td>C.2.06</td>
<td>Blade</td>
<td>Disabled</td>
<td>382</td>
<td>277-382</td>
</tr>
<tr>
<td>C.2.08</td>
<td>Blade</td>
<td>Disabled</td>
<td>329</td>
<td>301-387</td>
</tr>
<tr>
<td>C.2.14</td>
<td>Blade</td>
<td>Disabled</td>
<td>382</td>
<td>277-382</td>
</tr>
</tbody>
</table>

Total: 7  Filtered: 7
Active Energy Manager Integration

- IBM System Director Active Energy Manager is an advanced energy manager provided through IBM Systems Director.
- AEM monitors, measures and controls energy usage at the data center level.
- Support across a large spectrum of IBM and non-IBM systems. System z support available since z10 GA1.
- Monitoring functions can be used free of charge.
- Enables to monitor System z in context of a heterogeneous data center.
AEM Datacenter Trending of Energy and Environmental Data

Energy Managed System z Servers

<table>
<thead>
<tr>
<th>Select</th>
<th>Name</th>
<th>Average</th>
<th>Ambient Temperature</th>
<th>Exhaust Temperature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>BCL2</td>
<td>15.816</td>
<td>33</td>
<td>33</td>
<td>CEC</td>
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</table>
### IBM Integrated Energy Management

#### Tivoli energy management solution

<table>
<thead>
<tr>
<th>Feature</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Accounting for Energy</td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td>Storage &amp; Data Optimization</td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td>Energy-Aware Provisioning and Scheduling</td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td>Energy Dashboard for Business Service Management</td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>Optimize Energy Efficiency of Assets</td>
<td><img src="image5.png" alt="Image" /></td>
</tr>
<tr>
<td>Data Center Mapping and Thermal Maps</td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
</tbody>
</table>

#### Tivoli Monitoring for Energy Management

- **Enterprise Energy Optimization & Reporting**
- **Enterprise Alerting for IT and Facilities**
- **Enterprise Data Repository**
- **IT Assets**: Discover and Manage Non-IBM Systems
- **Facility Infrastructure Assets**: Discover and Manage IBM Systems
- **Enterprise Assets**: Security, Lighting, Fire, HVAC, Fire, CRAC, UPS, PDUs, Sensors
- **IBM Systems Director Active Energy Manager**: Active Energy Management, Views, Alerting, & Reporting for IBM Systems
zEnterprise 196 – Energy Efficiency and Management Summary

- Significant improvements in energy efficiency
  - Tremendous performance improvement with same energy footprint
- Enables additional efficiency gains
  - Water cooling option
  - Overhead cabling option
  - HV DV power input option
- Energy Monitoring and Management delivered as part of Unified Resource Manager
  - Extensive monitoring of energy consumption and key environmental parameters
    - Includes detailed and aggregated data for zEnterprise 196 and BladeCenter Extension
  - Integrated Energy Management Controls
- Integration into IBM Energy Management stack through Active Energy Manager
“You can’t make a product greener, whether it’s a car, a refrigerator or a city, without making it smarter: smarter materials, smarter software or smarter design.”

(Thomas Friedman, New York Times)

Thank You
z196 – Helping to Control Energy Consumption in the Data Center

- Better control of energy usage and improved efficiency in your data center

- New water cooled option allows for energy savings without compromising performance
  - Maximum capacity server has improved power efficiency of 60% compared to the System z10 and a 70% improvement with water cooled option

- Savings achieved on input power with optional High Voltage DC by removing the need for an additional DC to AC inversion step in the data center

- Improve flexibility with overhead cabling option while helping to increase air flow in a raised floor environment

- z196 is same footprint as the System z10 EC¹

¹ – Water cooling option adds 10.2 cm to depth, overhead cable option adds 30.5 cm to width
Watercooling for zNext
Three fundamentals of power management

Measure/Trend Power Consumption
- Determine the power being consumed now
- Trending energy and thermals over extended periods of time

Allocate Power Correctly
- Power consumed is a function of the HW configuration, environment, application mix, and system utilization.
- Allocate power based on past history using power measurements
- Rightsizing of power and cooling utilization
- Enables deployment of more servers within the physical limits of a data center

Reduce power consumed
- Reduce power in periods of low utilization to limit energy cost
- Allows reduction of power budget on other system(s)
  - Reduce energy footprint of a data center
  - Pinch-off, increase power budget other system(s)
## Management stack

Building an architectural construct of hardware, software, services

<table>
<thead>
<tr>
<th>Service Management</th>
<th>Platform Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visibility, Control and Automation for Applications, Transactions, Databases and Data Center Resources</td>
<td>Hypervisor management and creation of virtual networks</td>
</tr>
<tr>
<td>End-to-End Workload Management and Service Level Objectives that Align IT Management with Business Goals</td>
<td>Operational controls, service and support for hardware / firmware</td>
</tr>
<tr>
<td>Common Usage and Accounting for business accounting</td>
<td>Network management of private and secure data and support networks</td>
</tr>
<tr>
<td>Dynamic/Centralized Management of Application Workloads based on Policies</td>
<td>Energy monitoring and management</td>
</tr>
<tr>
<td>Business Resilience for multi-site recovery</td>
<td>Workload awareness and platform performance management</td>
</tr>
<tr>
<td>End to end Enterprise Security</td>
<td>Virtualization management – single view of virtualization across the platform</td>
</tr>
</tbody>
</table>

### Extending with Unified Resource Manager
Built on this construct -- zEnterprise -- Innovation at every level

Focused, collaborative innovation
A “complete systems” approach

1 All statements regarding IBM future direction and intent are subject to change or withdrawal without notice, and represents goals and objectives only.
zEnterprise Ensembles
Clustering these heterogeneous systems to create an ensemble

What is it?
Unified Resource Manager allows for the management and optimization of a zEnterprise System as a single resource pool.

An ENSEMBLE is a group of one to eight zEnterprise Systems to be managed as one single logical virtualized system. Each zEnterprise is a single z196 with 0-1 zBX attached.

Now business objectives can be put in terms of a performance policy for a workload that spans across the ensemble – the multiple systems.

When multiple workloads are running across the ensemble, each can have its own business objectives, and Unified Resource Manager can share the resources to meet all the business objectives.

How is it different?

- **Workload awareness**: Unified Resource Manager is able to optimize the total resources in the ensemble in accordance with the policies set for different workloads.

- **Single point of control**: Management of all resources in the ensemble is centralized on one Hardware Management Console. Dashboard monitoring of CPU resources and energy can allow time to react and make adjustments if necessary.

- **Integration**: The integrated management and built in networks of the ensemble are designed to reduce errors associated with distributed configurations. Reduction of complexity in day-to-day operations.
Putting zEnterprise System to the task
Use the smarter solution to improve your application design

System z Host
- z/OS
- z/TPF
- z/VSE™
- Linux on System z
- z/VM

Select IBM Blades
- Linux on System x™
- AIX on POWER7
- Blade Virtualization

Optimizers
- DataPower
- IBM Smart Analytics Optimizer

Blade HW Resources
- zBX

System z PR/SM™

z HW Resources
- Support Element

Private data network (IEDN)

Unified Resource Manager

Private Management Network INMN

Private High Speed Data Network IEDN

Customer Network

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