z/VM Charge Back Models and Methods
Version 3

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Agenda

- Introduction
  - What is a charge back model?
  - What are considerations to creating one?

- Survey of Different Models

- Methods and approaches to capturing the required data
  - z/VM Accounting Data
  - z/VM Monitor Data
Questions to Consider

- Why do charge back at all?
  - To be fair to different groups
  - To capture value of your services
  - To control or influence behavior

- What’s important to your users?
  - Predictability and consistency
  - Flexibility
  - Ease
  - Control

- IT strategy?
  - Cost recovery
  - Profit
What are Customers Doing?

Customer Charge Backs

- No: 39%
- Planning: 33%
- Yes: 28%
If Not, Why Not?

Corporate Direction
Not needed
Not worth the value
Business structure does not allow
No management interest

0% 20% 40% 60% 80% 100%

Factor  Non-Factor

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What’s Important to a Model Choice?

- **Scales**: will the model allow for dealing with 100s or 1000s of virtual machines? What’s the overhead?

- **Accurate**: does it associated the costs with the proper virtual machines or applications?

- **Predictable**: Is it predictable for end users? Will they have some knowledge or expectation of their bill for each month or quarter?

- **Brings Focus**: Does it help to bring focus to the value of improving efficiency and TCO?

- **Easy**: Is it a model that is easy to implement in effort or in time?
Breakdown of Criteria

More Important

Scales  Accurate  Predictable  Brings Focus  Easy
Charge Back Models
Models Examined

1. Pure Cost Center
2. Service Cost Allocation
3. Virtual Machine Flat Charge
4. T-Shirt Size Charge
5. Virtual Machine Usage Based
6. Linux Process Usage Based
7. Fix Resource Contract
Pure Cost Center - Description

- Treats IT as a pure Cost Center
- No charge back or recovery
- Collect costs for overall financial reporting
  - “IT is n% of Corporate Expenses”
Pure Cost Center – Considerations

- **Strengths**
  - Little for IT to implement
  - Very predictable for users

- **Weaknesses**
  - Little incentive for users or systems to be efficient
  - Focus on strategic decisions is often on expenses, and not on the potential value
  - Actual cost of end user services not as accurate
  - Can make IT a target for cuts
  - Can make initial z Systems projects look expensive due to larger base costs
Service Cost Allocation - Description

- View IT as a cost center, that is you provide services but don’t generate revenue directly

- Add up all the costs: HW, SW, Personnel, etc.

- Distribute across the users of the services

- How to distribute those costs for departments or lines of business?
  - Percentage of virtual machines
  - Percentage of business or revenue
  - Percentage of users supported
  - Percentage of overall processor time used
  - Some other straight forward calculation
Service Cost Allocation – Considerations

- **Strengths**
  - Fairly simple to implement
  - Allows some focus on value versus expense

- **Weaknesses**
  - Agreement on distribution method and fairness
  - Incentives for efficiencies not as obvious
  - Initial projects could be more expensive as base costs are distribute across fewer users
Virtual Machine Flat Charge - Description

- Create standard virtual machines with a fixed number of virtual processors, memory, and storage.

- Treats virtual servers like commodity servers or hardware.

- The ‘basic’ virtual machine would need to be large enough to contain largest workloads
  – One size has to fit all or performance has to be limited

- No need to track usage of virtual machines for charge back reasons

- Responsibility to ensure sufficient resources
Virtual Machine Flat Charge - Considerations

**Strengths**
- Implementation fairly straightforward
- Internal revenue for virtual resources instead of real resources
- Simple and predictable for user

**Weaknesses**
- No incentive by users for efficient use of resources or to tune their systems
- Loophole of no limit for how much work you put into a virtual machine
  - Example: Just keep adding JVMs in same virtual machine
- Difficult to do capacity planning
- Need to oversize virtual machines
  - Can cause other problems
T-Shirt Sizes - Description

- Variation of the Virtual Machine Flat Size

- Have various ‘sizes’ of virtual machines to select with a charge varies with the size

- Sizes normally reflect both processor and memory requirements.
T-Shirt Sizes - Considerations

- **Strengths**
  - Implementation fairly straightforward
  - Internal revenue for virtual resources instead of real resources
  - Simple and predictable for user
  - More fair than virtual machine flat charge

- **Weaknesses**
  - No incentive by users for efficient use of resources or to tune their systems
  - Loophole of no limit for how much work you put into a virtual machine
    - Example: Just keep adding JVMs in same virtual machine
  - Difficult to do capacity planning
Variation for Flat and T-Shirt Sizes

- Earlier models were based on virtual machines built
- Variation would be to charge based on logged on time
- Fairly easy to capture and gives incentive for virtual machines to be shutdown when not in use.
Virtual Machine Usage Based - Description

- Charge back based on absolute real resource usage
  - Processor
  - Memory
  - Network
  - Storage

- Virtual Machine Level
  - Typically done at this level
  - Data is easily gathered from z/VM
Virtual Machine Usage Based - Considerations

- **Strengths**
  - Flexible – pay as you go
  - Tracks back to cost recovery
  - Various tools exist to facilitate this approach
  - Incentive for tuning and improving efficiency

- **Weaknesses**
  - More complex than other approaches
  - Need method to adjust for loops or runaway scenarios
Linux Process Usage Based - Description

- Charge back based on absolute real resource usage
  - Processor
  - Memory
  - Network
  - Storage

- Linux Process Level
  - Valuable when multiple applications in a virtual machine (though that has other downsides)
  - Requires pulling Linux process data
Linux Process Usage Based - Considerations

- Strengths
  - Flexible – pay as you go
  - Tracks back to cost recovery
  - Handles virtual machines with mixed applications
  - Incentive for tuning and improving efficiency

- Weaknesses
  - More complex than other approaches, need to capture process level information
  - Need method to adjust for loops or runaway scenarios
A Few Comments on CPU Time

- Things you may need to consider:
  - Processor speed changing for environment reasons
  - Processor speed changing for DR environments
  - Processor speed differences between SMT disabled and enabled
  - Processor speed differences between different members in an SSI Cluster
  - Processor speed differences in a VM-mode LPAR between the general purpose processors and the IFL processors
Individual Resource Limit Based - Description

- Paid for a fixed limit or capacity of resources, typically processor usage

- Create a cap or limit for individual virtual machines via SHARE ABSOLUTE LIMITHARD

- Determine the correct ‘limit’
  - MIPS
  - Percentage of an IFL
Individual Resource Limit Based - Considerations

- **Strengths**
  - Predictable for the end user
  - Could ‘purchase’ different amounts based on heavier periods of the activity across the year

- **Weaknesses**
  - Computing a value (MIPS) on which everyone can agree
  - Having to set individual LIMITHARD for virtual machines
    - Percentage varies if you change number of logical processors
    - Multiple virtual machines may be needed or not needed at times
  - Difficult for workloads that vary greatly
  - Unused resources, while paid for, are wasted
Group Resource Limit Based - Description

- Like the Individual Resource Limit Model but for a set of virtual machines on a given z/VM system

- Paid for a fixed limit or capacity of resources, typically processor usage

- Create a cap or limit for individual virtual machines via CPU pools

- Determine the correct ‘limit’
  - MIPS
  - Percentage of an IFL
Group Resource Limit Based - Considerations

- **Strengths**
  - Predictable for the end user
  - Could ‘purchase’ different amounts based on heavier periods of the activity across the year
  - Purchase for a group of virtual machines without need to know which will be used

- **Weaknesses**
  - Computing a value (MIPS) on which everyone can agree
  - Difficult for workloads that vary greatly
  - Unused resources, while paid for, are wasted
Variations and Other Options

- Provide ‘discount’ for resources used off-shift or off-peak hours

- T-shirt model with service goals
  - Example:
    - $ Discount Machine: Low Limit hard Share Setting
    - $$ Standard Machine: Limitsoft Share Setting
    - $$$ Gold Machine: No limit share
Other Considerations

- Put yourself in your user’s position. How would you (they) try to work the system? What loop holes are there? What would you not like about it?

- Where are your costs in terms of managing the system, particularly in people time?
  - Build? Capacity Planning? Network modifications?

- Ask about the dynamic nature of the environment.
  - If cost recovery from the systems team is important, than understanding what can change and how frequently is valuable.

- How large will the environment scale?
  - Some approaches are easy for a few dozen guests, but become more challenging when talking about 100s of virtual machines.
Summary of Models

- **Linux Usage Based**
  - Fair
  - Scales
  - Predictable
  - Focus on Improvement
  - Ease of Implementation

- **VM Usage Based**
  - Fair
  - Scales
  - Predictable
  - Focus on Improvement
  - Ease of Implementation

- **T-Shirt Sizes**
  - Fair
  - Scales
  - Predictable
  - Focus on Improvement
  - Ease of Implementation

- **VM Flat Charge**
  - Fair
  - Scales
  - Predictable
  - Focus on Improvement
  - Ease of Implementation

- **Service Cost Allocation**
  - Fair
  - Scales
  - Predictable
  - Focus on Improvement
  - Ease of Implementation

- **Pure Cost Center**
  - Fair
  - Scales
  - Predictable
  - Focus on Improvement
  - Ease of Implementation
What Models are Customers Using?

- Virtual Machine Resource Based: 60%
- Pre-sell Fixed 20%
- T-Shirt Size 20%
Billing or Charge Back in z/VM Environment

- z/VM has interfaces that allow for performance and accounting data to be generated and collected. Examples of this information includes:
  - Processor time consumed
  - Processor or capacity available
  - Memory usage and activity
  - I/O activity
  - Network activity and capacity

- IBM and other ISVs provide tools and products to reduce and report this information with various degrees of sophistication

- Information can be grouped or aggregated via accounting numbers or other information.
Primary Data Sources

- z/VM Monitor System Service
  - Monitor Records
  - Scales really well
  - Lots of data

- z/VM Accounting System Service
  - Accounting Records
  - Exact, uses interlocked instructions
  - Smaller amount of data

- Linux Performance or Accounting Data
Overview

Virtual Machine

MONDCSS (Shared Memory)

*MONITOR

z/VM Control Program

Virtual Machine

*ACCOUNT

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Accounting Records

Virtual Machine

ACCOUNT

Virtual Machine

RETRIEVE

z/VM Control Program

*ACCOUNT

Account Report
ACCOUNT Utility

- Included in z/VM and documented in CMS Commands and Utilities Reference
Accounting Data through CMS PIPELINES

- CMS Pipelines is a powerful programming model in z/VM that can be used in REXX programs.

- Included in Pipelines is a stage called STARMSG that allows one to connect to *ACCOUNT directly.

Virtual Machine

Accounting Data through CMS PIPELINES

- CMS Pipelines is a powerful programming model in z/VM that can be used in REXX programs.

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Monitor Record Processing

Virtual Machine
MONWRITE

MONDCSS
(Shared Memory)

*MONITOR

z/VM Control Program

Virtual Machine
PERFKIT

Trend Files

Performance Reports

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Performance Toolkit for z/VM

- Priced featured of z/VM

- Real time monitor
  - Optionally create human readable reports on regular intervals (each shift, once a day, etc)

- Batch processor of raw Monwrite files

- Human Readable Reports

- Summary/Trend/History files

- Very robust data covering z/VM level in great detail
CSVGEN for Performance Toolkit

- Available on z/VM Home Page

- Converts Performance Toolkit Summary/Trend/History files to CSV files for import into spreadsheets or databases


- Process:
  - Take Toolkit files
  - CSVGEN format toolkit_file output_fm prefix (options
    - Format: Summary or Trend
    - Prefix: prefix the output file names
IBM Smart Cloud Cost Management

- Formerly known as ITUAM – IBM Tivoli Usage and Accounting Manager
- SCCM supports both z/VM and Linux for z Systems as well as:
  - Windows®, VMware, AIX®, Linux, z/OS
- Uses z/VM Accounting records to create CSR (Common Source Resource) files which is its standard input
- z/VM based reports cover:
  - Connect Time
  - CPU Time
  - Virtual I/O (traditional SSCH based)
  - Unit record information (spool)
- Linux data includes process information:
  - System and user processor usage
  - Blocks read/written
  - Average memory usage
OMEGAMON XE

- Tivoli Data Warehouse (TDW) component captures and stores performance data

- Various reporting tools available with TDW

- Any report can be exported as a CSV file
Summary

- If you’d like to add to the charge back survey, see:
  - https://ibm.biz/bitchargebacksurvey

- Various models exist
  - Need to understand the pros and cons of each
  - Need to think how the model will influence behaviour

- Various methods exist to implement the models
  - Create your own
    - z/VM Monitor Data
    - z/VM Accounting Data
    - Linux Performance and Accounting Data

- IBM Products and Tools
  - ACCOUNT Utility
  - Performance Toolkit for z/VM
  - OMEGAMON XE
  - IBM Smart Cloud Cost Management
References

- Red paper on Accounting and Monitoring for z/VM Linux guest machines
  - A little dated but includes some examples for doing your own thing

- Red book on ITUAM