IBM Z

# Operational Monitoring and Automation of z/VM and Linux on IBM Z

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IBM

# Agenda

- Introduction to recommended practices and examples
- IBM Operations Manager for z/VM
  - Overview
  - Customer experiences
- Considerations for z/VM Single System Image
- Recommended practices in detail
  - Live demonstrations
- Summary
  - Reference information
- Additional demos
  - Configuration options and sample code for all demos

# IBM Solutions

- Security
  - RACF and zSecure Manager for z/VM
- Performance monitoring
  - OMEGAMON XE on z/VM and Linux
  - Performance Toolkit for z/VM
- Backup and recovery
  - Backup and Restore Manager for z/VM
  - Tape Manager for z/VM
  - Storage Protect (aka Spectrum Protect or Tivoli Storage Manager)
- Automation and operational monitoring
  - Operations Manager for z/VM
    - Including integration with existing monitoring and alert systems

# Complete Solution for Management of the z/VM and Linux IBM Z or LinuxONE Environment

## IBM Infrastructure Suite for z/VM and Linux V2

### OMEGAMON XE on z/VM and Linux

Performance monitoring of z/VM hypervisor and Linux guests

### Storage Protect

File level backup and recovery for Linux virtual machines

### Operations Manager for z/VM

- Facilitate operational monitoring and automated operations
- Take action based on events

### Backup and Restore Manager for z/VM

- Image and file level backup/restore of z/VM environment
- Image level backup/restore of Linux

### Cloud Infrastructure Center

*(optional separately priced feature)*

IaaS offering that provides industry-standard user experience for both traditional and cloud infrastructure

### Tape Manager for z/VM

*(optional separately priced feature)*

Support Backup and Restore Manager performing backups to and recovery from real or virtual tape systems

**Single PID: 5698-K01 (S&S 5698-K02)**

# Recommended Practices – Operational Monitoring and Automation

**Console monitoring and viewing – current state and historical**

- Operations staff monitoring a central console of alerts
- System programmers debugging a problem on a guest or service machine
- Console log data available for audits or future reference

Gather Data

Keep monitoring close to the operating system

React

**Generate alerts and/or automatically recover from**

- Abend, termination, or error messages
- Service machine disks approaching full
- Critical user IDs or guests being logged off or entering error state
- Spool and/or page space approaching full

Monitor as you grow

Prevent

**Schedule automated system maintenance procedures**

- Spool cleanup based on policies
- Minidisk cleanup (from logs), including archiving
- Orderly startup and shutdown
  - Relocation of critical guests to another SSI member
- Backups of z/VM system

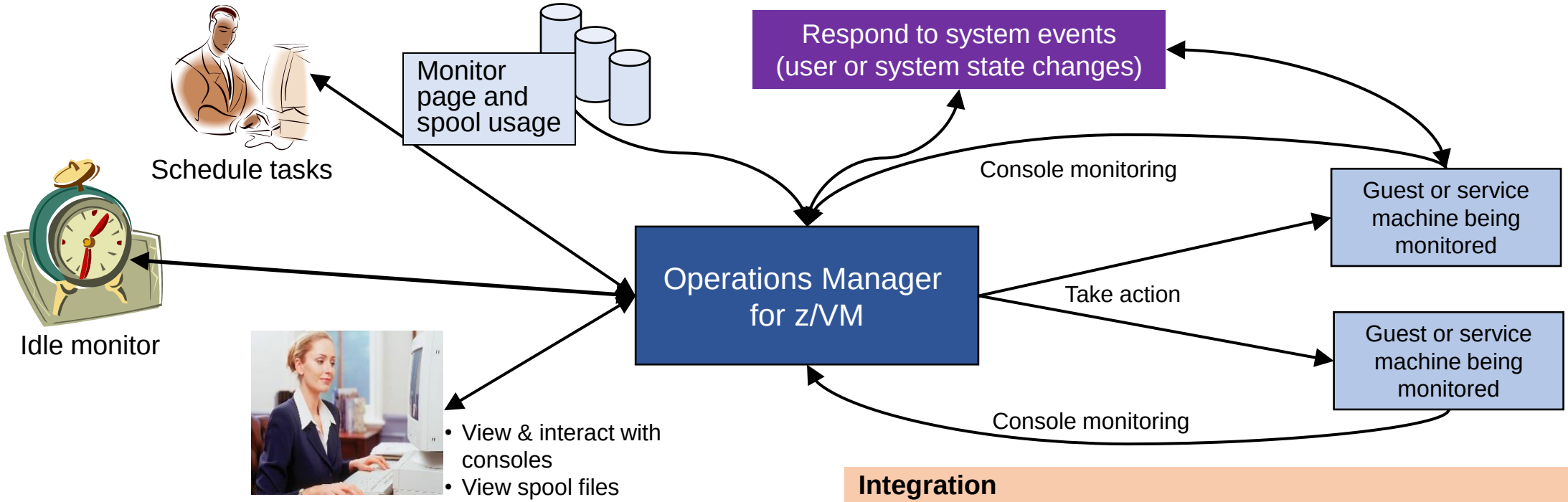
# Product Overview

*IBM Operations Manager for z/VM*

# Operations Manager for z/VM

**Increase productivity**
- Authorized users to view and interact with monitored virtual machines without logging onto them
- Multiple users view/interact with a virtual machine simultaneously

**Improve system availability**
- Monitor virtual machines and processes
- Take automated actions based on console messages
- Reduce problems due to operator error




**Automation**
- Routine activities done more effectively with minimal operations staff
- Schedule tasks to occur on a regular basis

**Integration**
- Fulfill take action requests from performance monitoring products
  - OMEGAMON XE on z/VM and Linux, etc.
- Send alerts to email, central event management systems, analytics
  - Netcool/OMNIbus), etc.

# Executing Actions

- Specify action to take in response to
  - Console rule definition
  - Schedule
  - Spool monitor
  - Etc.
- Types of actions
  - Change color, highlight, hold, or suppress a console message
  - **CP or CMS commands**
  - **Rexx** EXECs, for example:
    - Send email
    - Send SNMP trap
    - Clean up a disk
  - **Write** data to a **TCP/IP** address/hostname and port
    - Send data to a syslog daemon/server
    - Send to any log analytics processor

# Executing Actions

- **Dynamically include data** about the triggering event
  - Available to the action via substitution variables
- **Limit** the number of times an **action** is taken in a specified period of time
  - Avoid executing action repeatedly
  - Take a different action when the limit is reached
- Take multiple actions based on one message, event, schedule, etc.
  - Chain actions together
- Execute the action on another LPAR running Operations Manager
  - Communication is IP-based
  - **Does not require SSI**

# Dynamic Configuration

- **Initial configuration** file loaded at startup
  - May imbed other configuration files
  - Filename can be a substitution variable for the system name
- Most **configuration options** can be **updated** while **Operations Manager is running**
  - Add, delete, or change:
    - Rules, actions, monitors, schedules, holidays, groups, user authorization
  - **Suspend or resume** rules, monitors, schedules
- Multiple methods
  - CMS command interface
  - (Re)load a new or updated configuration file
  - Commands in action routines
- **Sample configuration** files provided
  - Includes some of the demos in this presentation
    - Operations Manager configuration statements
    - **Sample Rexx** code

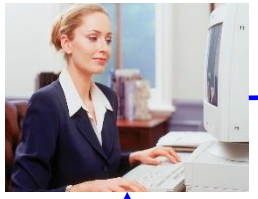
# Features and Functions

- Monitor service machine consoles
- Monitor page space and spool usage
- Monitor system events
- Schedule events/actions
- Take actions automatically based on monitoring results
  - Includes taking actions on other z/VM systems with Operations Manager
- View and interact with monitored consoles from authorized user IDs
- Find and view spool files
- Dynamic configuration
- Separation of access control

View and Issue Commands on Consoles
*Linux Guests and CMS Service Machines*

Generate Alerts and/or Automatically Recover From
*Abend Messages*
*Termination Messages*
*Error Messages*

# Monitor Guest and Service Machine Consoles



Operations Manager

slog Message 1
slog Message 2
slog Message 3
…

syslog data

OPER Message 1
OPER Message 2
OPER Message 3
…

OPERATOR

LNX Message 1
LNX Message 2
LNX Message 3
…

LINUX

TCP Message 1
TCP Message 2
TCP Message 3
…

TCPIP

TEST Message 1
TEST Message 2
TEST Message 3
…

Test data

Data space 1
TEST Message 1
**TEST Message 2**
…

Data space 2
LNX Message 1
LNX Message 3
…

Data space 3
OPER Message 1
**OPER Message 2**
…

Data space 4
TCP Message 1
TCP Message 2
…

Data space 5
slog Message 1
slog Message 2
slog Message 3
…

Filtered

Data space 6
OPER Message 1
LNX Message 1
LNX Message 2
TCP Message 1
slog Message 1
OPM Message 1
TEST Message 1
OPER Message 2
…

Daily log
OPER Message 1
LNX Message 1
LNX Message 2
TCP Message 1
slog Message 1
OPM Message 1

Unfiltered (with masking)

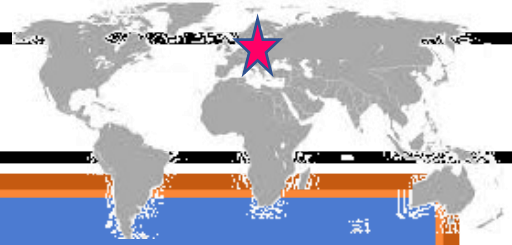
# View and Interact with Consoles

- Authorized users can **view live consoles** of monitored service machines & guests
  - **Multiple users** can view the same console simultaneously
  - No need to logon to the user ID to see its console
    - No interruption of the user ID
  - No need to create and close console files of disjointed data
  - Test data and Linux syslog data treated as a “console”
  - Views can be defined to look at a group of consoles in one view
  - Can specify a date and time range for your view within currently available data
  - Can request a copy of the current console data for a user or set of users (disk or reader file)
  - Format of date in the view is based on requestor’s CP DATEFORMAT setting

- Full screen mode
  - **Scroll** up and down to view and search historical data
  - Auto scroll (on or off) as new output is displayed on the console
  - From command line, **issue commands** back to the monitored console
- Amount of data that is visible depends on specified or default data space size
  - Or date/time range specified

- Rules/actions may modify the view
  - **Suppress messages** from the console
  - **Hold or highlight messages** with color, blinking, etc.
- Authorized users can view the log file
  - Can also request a copy of the log file from today or a previous day

# Capturing Linux Log Data



**The Situation:**

- z/VM console data being captured
- No Linux console data
- Linux log data stored locally on each guest
- Linux server crashes and corrupts file system
- No log data to debug/analyze the problem

## Initial Solution

**None**

- No log data
- Concerned about too much data being captured on z/VM for Linux guests

## Final solution

**Capture Linux console & log data**

- Console data captured on z/VM and forwarded to Splunk
- Syslog data sent directly to Splunk

# Monitor Service Machines

- Define rules to
  - Scan **console messages** for **text matching**
    - Includes column, wildcard, and exclusion support
    - Optionally restrict to specific user ID(s)
  - **Take actions** based on matches
- Multiple rules can apply to one message
  - Rules processed in order of definition in the configuration file
  - FINAL option available to indicate no additional rules should be evaluated

# Generate Alerts and/or Automatically Recover From

*Critical User IDs or Guests Logging Off*

*Critical User IDs or Guests Enter Error State*

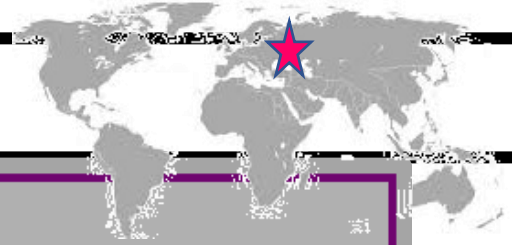
# Respond to System Events (Guest State Changes)

- Create monitors for z/VM system events (*VMEVENT)
  - Class 0, related to **user IDs**
    - 0 - Logon
    - 1 - **Logoff**
    - 2 - Failure condition (including **CP READ and Disabled Wait**)
    - 3 - Logoff timeout started
    - 4 - Forced sleep started
    - 5 - Runnable state entered (VM READ)
    - 6 - Free storage limit exceeded
    - 9 - Outbound relocation started
    - 10 - Inbound relocation started
    - 11 - **Outbound relocation complete**
    - 12 - Inbound relocation complete
    - 13 - **Outbound relocation terminated**
    - 14 - Inbound relocation terminated
    - 15 – Timebomb exploded
  - Optionally restrict to specific user ID(s)

# Respond to System Events (System State Changes)

- Class 2 and 3, **related to SSI**
  - 7 – SSI Mode (Stable, Influx, Safe)
  - 8 – SSI Member State (Down, Joining, Joined, Leaving, Isolated, Suspended, Unknown)
- Class 4, related to **networking**
  - 16 – Device activated
  - 17 – Additional device activated
  - 18 – Device deactivated, connection to hardware still operational
  - 19 – Device deactivated, connection to hardware not operational
- Specify the **action** associated with the event
  - Actions specified are the same as those for schedules, console rules, and other monitors

# Stopping and Restarting TCPIP



**The Situation:**

- Want to “bounce” TCPIP server on z/VM on dev/test system
- No access to HMC or system console
- If issue shutdown or FORCE for TCPIP then lose TN3270 access to system

## Initial solution

Find and coordinate with on-site operations staff who have system console or HMC access

## Final solution

**Monitoring & automation tool**

- Monitor for CP event indicating TCPIP has logged off
- Automatically XAUTOLOG it
- Easily bounce TCPIP as needed without relying on operations staff

# Generate Alerts and/or Automatically Recover From

*Spool Space Approaching Full*

*Page Space Approaching Full*

# Monitor Page and Spool Usage, View Spool Files

- Create page and spool space monitors to trigger actions when
  - Percent of spool usage falls within a **specified range**
  - Percent of spool usage increases at a specified rate
  - Percent of page space usage falls within a specified range
  - Percent of page space **usage increases** at a specified rate
- Actions triggered can be the same actions used by console monitoring
- For spool files, authorized users can
  - Use **full screen interface to list of spool files** based on one or more attributes
    - Owner
    - Size
    - Date created
  - From the list, the user can
    - **Sort** the list on any of the available columns
    - **View the contents** of an individual spool file
    - **Purge,** transfer, or change a spool file
  - Includes information on spool volume name(s) where each spool file is located
    - Easily find all spool files on a specific spool volume

# Spool and Page Space Full

**The Situation:**

- **Spool** and **page** space **fill up**
- System abends
- **Unplanned outage**

## Initial solution

### Homegrown tool

- Create a service machine running WAKEUP
- Check spool and page space percent full on regular intervals
- Maintain service machine and code for this one function

## Final solution

### Monitoring tool

- Simple monitor setup
- Watch for percent full to be within threshold range
- Watch for sudden growth
- Take action
- Easily add or change threshold or frequency
- Included in general monitoring/automation

Schedule Automated System Maintenance Procedures

Monitor for Rules, Monitors and Schedules Not Triggered

*Spool Cleanup Based on Policies*
*Backups*
*Disk Cleanup*
*Orderly Startup and Shutdown*

# Schedule Events and Actions

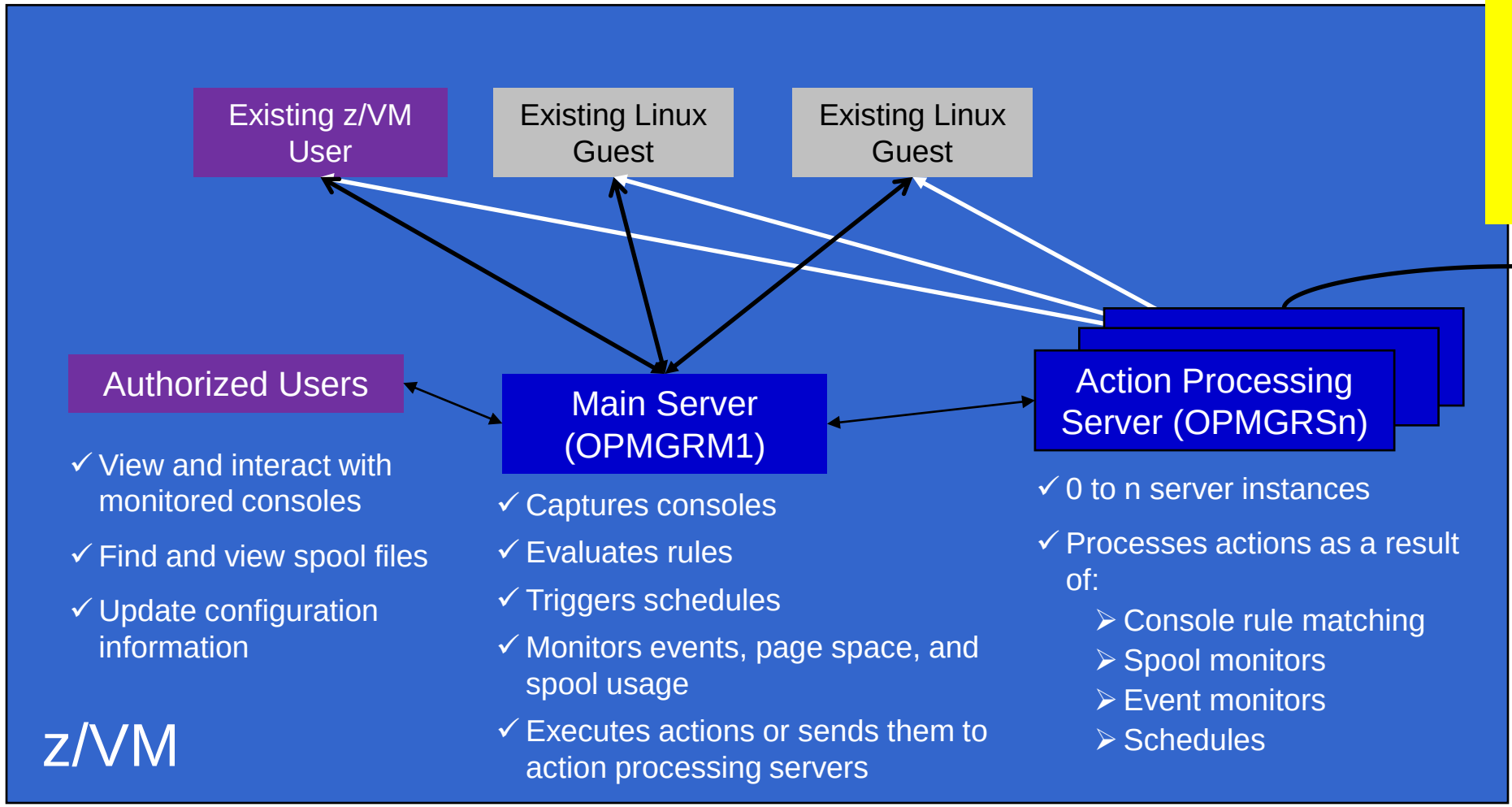
- Define schedules
  - Hourly, daily, weekly, monthly, or yearly, nth weekday of the month
  - Once on specified month, day, year, and time
  - Based on ISO week definitions (week number; even, odd, first, last week)
  - At regular intervals
    - Every x hours and y minutes
  - Within a specified window of time
    - Specify start time
    - Specify conflicting schedules
    - Specify maximum time to defer this schedule
  - Within limits
    - Restrict to specific days of the week: Monday through Sunday plus holidays
    - Restrict to certain hours of the day
- Specify the action associated with the schedule
  - Actions specified are the same as those for console rules and all other monitors

# Idle Monitors

- Define idle monitors
  - Watch for idle rules, schedules, and monitors
    - Rule, schedule, or monitor **not triggered *n*** number of times within specified period of time
- Specify the action associated with the idle monitor
  - Actions specified are the same as those for schedules, console rules, other monitors

# SSI vs non-SSI Considerations

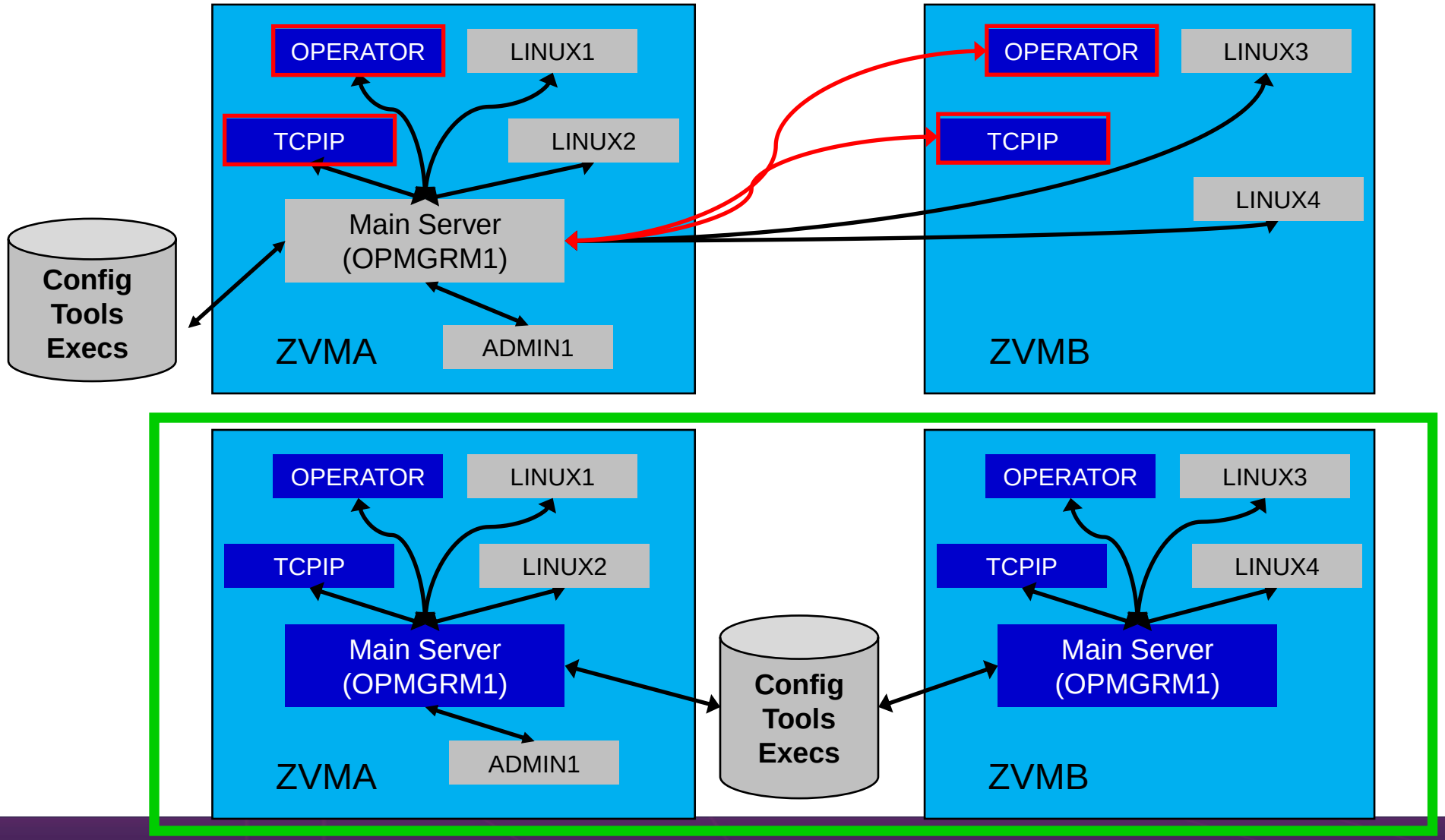
# Operations Manager - non-SSI Environment



# SSI Considerations

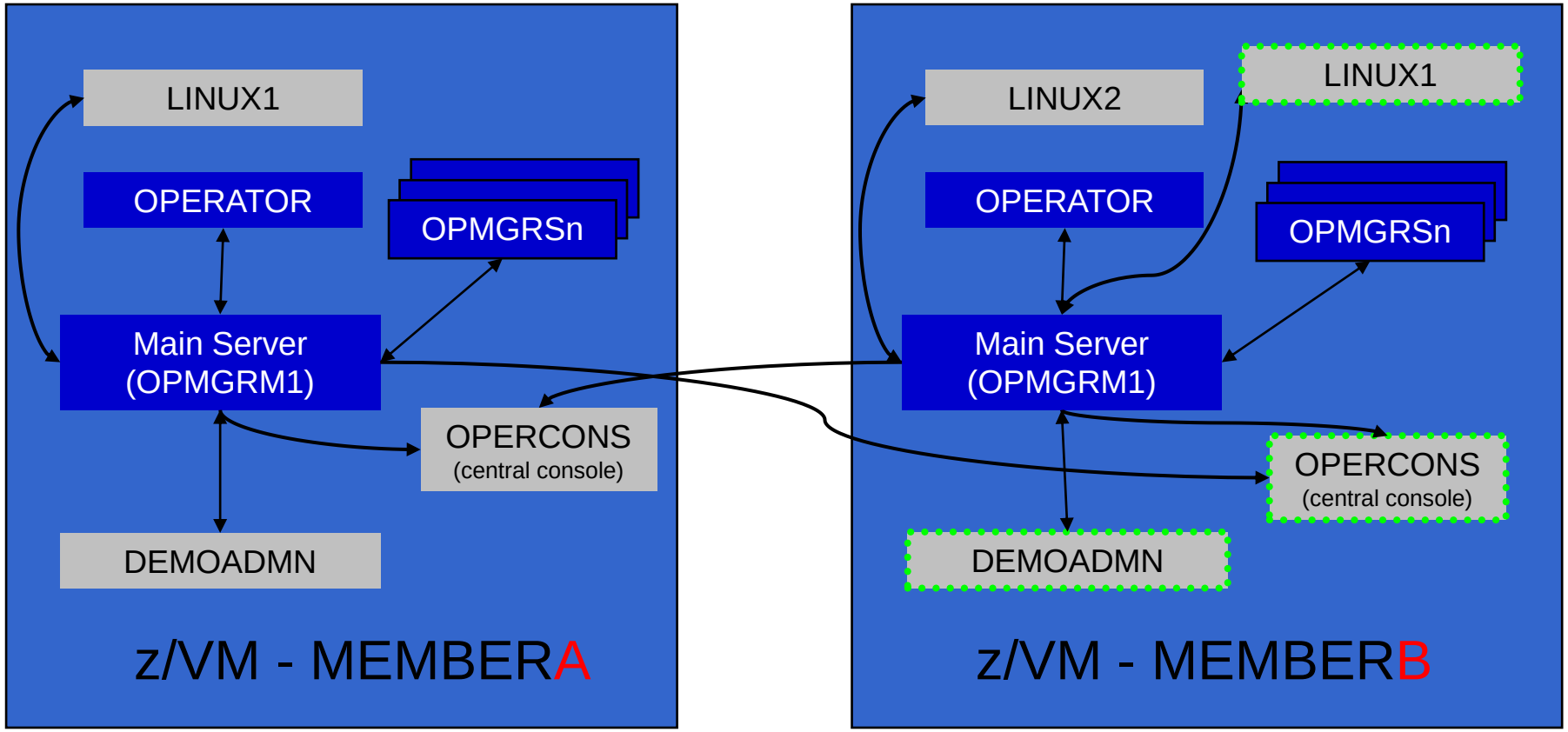
*Console Monitoring*

# SSI Considerations for Console Monitoring



# Operations Manager in SSI Cluster - Example

- Multiconfiguration users: OPMGRM1, OPMGRSn, OPERATOR, MAINT
- Single configuration users: LINUX1, LINUX2, OPERCONS, DEMOADMN
  - May relocate OPERCONS and DEMOADMN manually (supported) or via VMRELOCATE (unsupported, but you can make it work)



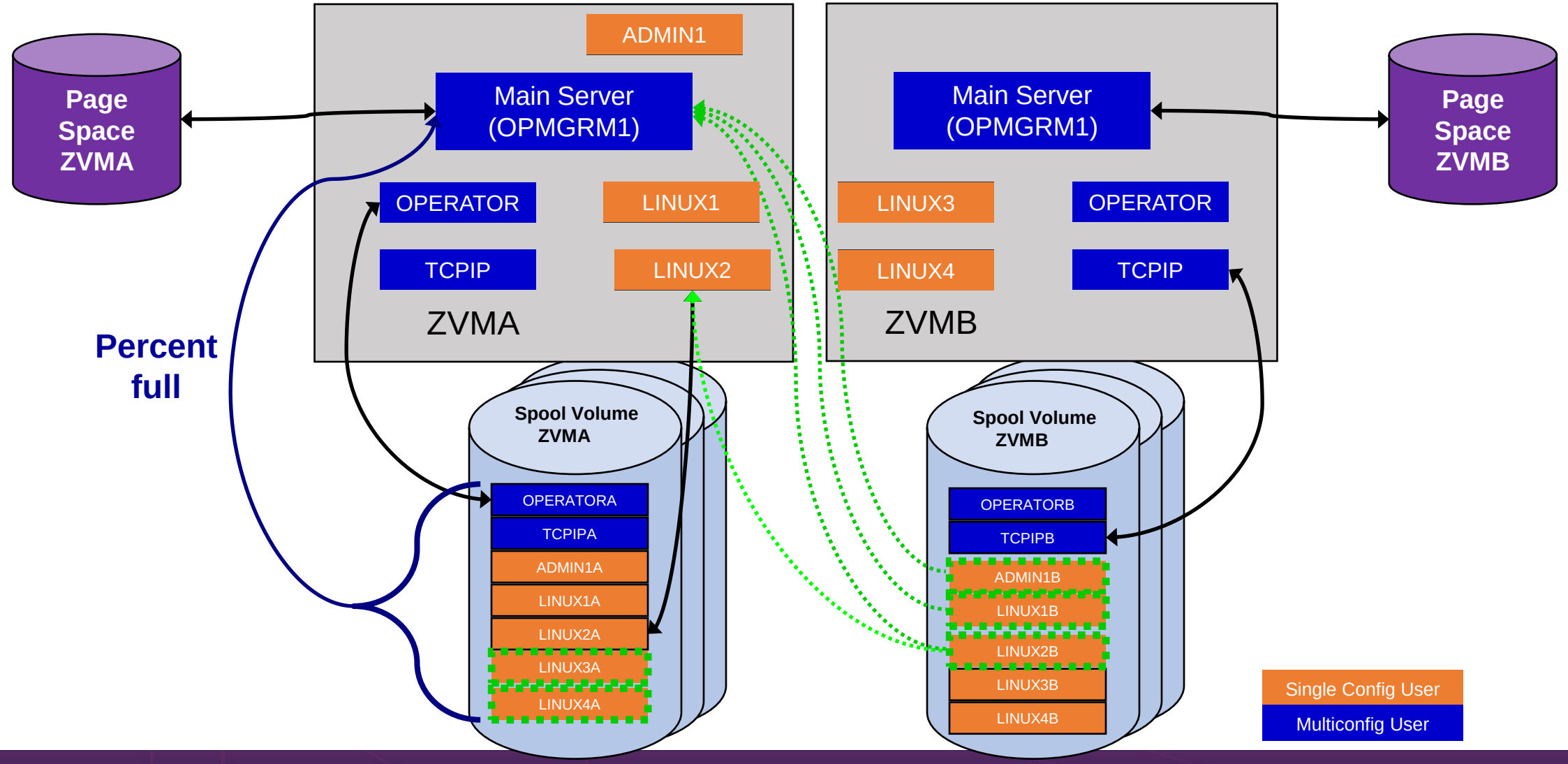
# Monitor Service Machines - Considerations

- Consoles received by Operations Manager via SECUSER or OBSERVER
  - Prefer SECUSER
    - OBSERVER won't detect CP and VM READ messages
    - Output of actions on OBSERVEd console may not be viewable in console
  - OBSERVER allows Operations Manager to receive console output even if user is logged on
- SSI allows SECUSER and OBSERVER across members of cluster in some situations
  - Content does not contain member name information
  - Rules, actions, and users wouldn't be able to distinguish between IDENTITY users on multiple members
  - Creates single point of failure on one member
- Recommendation for z/VM Single System Image environments
  - Have all consoles monitored by an Operations Manager server on the same member as the monitored guest (i.e. all Operations Manager servers are IDENTITY users)
    - Requires action processing servers (OPMGRSn) to be on same member as main server
  - Share configuration data on 198 minidisk owned by OPMGRM1 but in IDENTITY section (not SUBCONFIG section)
    - OPMGRM1 links the disk read only, files updated from system programmer user IDs
    - Main configuration file unique to each member
    - Imbed common file(s) used by all members
  - Request a copy of the current console of a remote user
    - `SMSG OPMGRM1 at membername VIEWCON USER userid MODE RDR`

# SSI Considerations

*Page Space Monitoring*
*Spool Space Monitoring*
*Viewing and Managing Spool Files*

# SSI Considerations for Page and Spool Space Monitoring



# Spool and Page Space Monitoring - Considerations

- Page space is local
  - Separate space for each member and only visible to the local member
  - **No impact from SSI**
- Spool data
  - Spool files are placed on spool volumes owned by the member where the spool file was created
  - Users see their own spool data no matter where they are logged on and where the data was created

# Spool and Page Space Monitoring - Considerations

Users and applications (like Operations Manager) who can see all spool files need to be aware:

- Spool data for **multiconfiguration** users
  - Only spool files owned by the local instance of that user are visible on the local member
  - No visibility to spool files owned by other instances of that user on other members
- Spool data for single configuration users:

| **Single configuration user** status | All spool files created on **this** member | PRT/PUN files created on **other** members | RDR files created on **other** members |
|---|---|---|---|
| User logged off | Visible | Visible | Not visible |
| User logged onto **this** member | Visible | Visible | Visible (but not on local spool volumes) |
| User logged onto **another** member | Visible | Visible | Not visible |

# Spool and Page Space Monitoring - Considerations

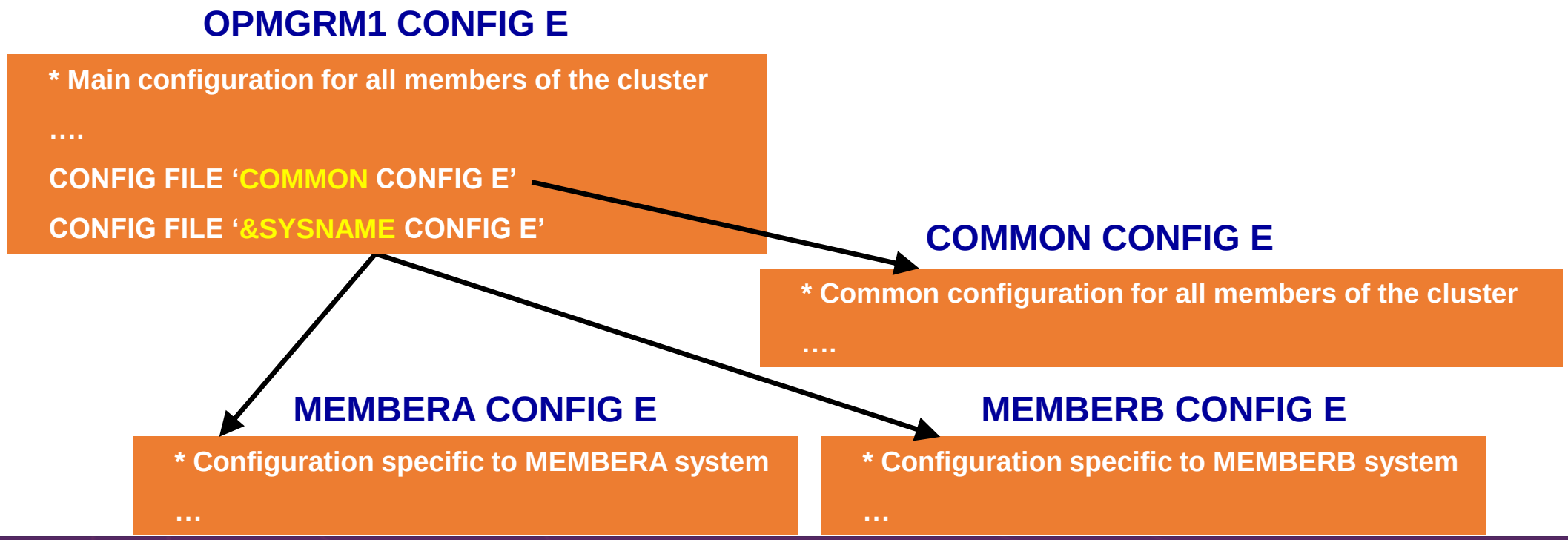
- Recommendation
  - Have an Operations Manager server on each member to monitor spool and page space
  - Be aware of spool files visible in Operations Manager but not resident on this member's spool volumes
    - Indicated with "+" in VIEWSPL

# SSI Considerations

*Managing Configuration Files*

# Managing Configuration Files

- Put all configuration files on a shared disk
  - Default is 198 disk for OPMGRM1 – in **IDENTITY** section
  - Alternatively SFS
- Create a main configuration file with authorizations and system settings – shared by all members
  - All Operations Manager servers on all members load this file
- Create a common configuration file used by all members
- Imbed a unique configuration file based on the system name of this member



# Summary

*References*

*Demos – Including Screenshots, Configuration Info, Rexx*

# Recommended Practices – Operational Monitoring and Automation

**Console monitoring and viewing**

- Operations staff monitoring a central console of alerts
- System programmers debugging a problem on a guest or service machine
- Console log data available for audits or future reference

VIEWCON
VIEWLOG
Log file

**Rules**
**Event monitors**
**Spool/page monitors**

**Generate alerts and/or automatically recover from**

- Abend, termination, or error messages
- Service machine disks approaching full
- Critical user IDs or guests being logged off or entering error state
- Spool and/or page space approaching full

**Schedules**
**SFPURGER**
**Rules**
**Backup Manager**

**Schedule automated system maintenance procedures**

- Spool cleanup based on policies
- Minidisk cleanup (from logs), including archiving
- Orderly startup and shutdown
  - Relocation of critical guests to another SSI member
- Backups of z/VM system

# Summary

- Use Operations Manager to
  - **Automate** daily operations
  - **Integrate** your z/VM and Linux on IBM Z environment with existing enterprise monitoring and **alerting**
  - Prevent problems rather than react to them
  - Automate reactions to problems when they can't be prevented
  - **Improve problem determination** procedures
  - Increase programmer and operator productivity
  - Continue to monitor locally with improved management of clusters
- Sometimes several alternatives for monitoring for the same event
  - Console message (rules)
  - Scheduled healthchecks (schedules)
  - User ID status changes (event monitor)
- Actions allow integration with other platforms and products

# Reference Information

- Web sites
  - Product page: https://www.ibm.com/products/operations-manager-for-zvm
    - Publications, presentation, white papers
    - Pre-requisites
    - Support
- White papers on Operations Manager website (Resources tab)
  - Routing Linux syslog data
  - Sending alerts from Operations Manager to Netcool/OMNIbus
  - Using Shared File System to store Operations Manager configuration files and automation EXECs
  - Automatically logging on a user at Linux system boot time for easier console management and action execution
- **IBMVM** Mailing list
  - http://listserv.uark.edu/archives/ibmvm.html

धन्यवाद

Hindi

多謝

Traditional

감사합니다

Korean

Спасибо

Russian

Ndzi khense ngopfu

Tsonga

Gracias

Spanish

Thank You

English

شكراً

Arabic

Grazie

Italian

Obrigado

Brazilian Portuguese

Danke

German

Ke a leboha

Tswana

多谢

Simplified Chinese

Merci

French

நன்றி

Tamil

ありがとうございました

Japanese

ขอบคุณ

Thai

# Demonstration Scenarios

# Automation Demos Available

1. **View consoles of Linux guests, Linux syslog data, and CMS user IDs or service machines**
2. Send an e-mail based on a console message
3. **Send an alert to Netcool/OMNIbus based on a console message, hold and unhold messages**
    a. Using POSTZMSG interface to Netcool/OMNIbus
    **b. Using SNMP interface to Netcool/OMNIbus**
4. **Send a message or email if spool approaches full**
    a. Send a message if spool usage is too high on any member of an SSI Cluster – see how spool files appear in SSI
    **b. Send an email if spool usage is too high on a single system**
5. **View and clean up spool files**
6. Automated spool cleanup
7. **Archiving DIRMAINT's log files when disk gets full**
8. Process a file of test messages as a console
9. Process Linux syslog data as a console
10. Create a central operations console on one z/VM system
11. Create a central operations console across multiple z/VM systems
    a. When the systems are in an SSI cluster
    b. When the systems are not in an SSI cluster
12. **Monitor service machines for logoff – and autolog them**
13. Send an email if page space approaches full
14. Monitor SSI connectivity between 2 cluster members
15. **Suppress passwords on Linux consoles**
16. Autolog a Linux guest and send message if doesn't start successfully
17. Monitor Linux file system and send email when approaching full
18. Send alerts to other tools via syslog
19. Non-SSI high availability environment: monitor LPAR CPU utilization – if too high, stop a guest and restart on another LPAR