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Increasing ICF Catalog Availability With Tivoli Advanced Catalog Management for z/OS

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Session 10974

Agenda

- Issues and Risks
- Catalog Availability
- Catalog Backup
- Catalog Diagnostics
- Catalog Recovery
- Catalog Reorganization
- Splitting and Merging Catalogs
- Monitoring Catalog Health
- Disaster Recovery Support

ICF Catalogs Are Critical

- Why Are Catalogs Important?
  - All current and migrated data is cataloged
  - Cataloged data is not accessible if the catalog is not available
  - If a catalog becomes damaged and is out of service, large amounts of business data will be unavailable until the catalog is recovered
  - Compare the loss of a catalog to the loss of access to your company phone and email list – how would you contact someone when you needed them?

Business Issues

- ICF catalogs are a single point of failure
  - If a catalog is unavailable all applications that access that catalog suffer an outage
  - Forward recovery software is required for resiliency
- Compliance with government or industry regulations
  - Regulations require customers to be resilient to any type of outage
- Support business resiliency initiatives
  - You are more likely to suffer a catalog failure than experience a disaster
  - Businesses invest millions in disaster recovery solutions

Recognize Your Risks

- ICF Catalogs Are Extremely Critical to z/OS
  - All current and migrated data is cataloged
  - Cataloged data is not accessible if the catalog is not available
- What Makes This Critical? You Probably Have:
  - A very high number of data sets
  - A very low number of catalogs

Recognize Your Risks

- Like Most Installations, You Are at Risk
  - Keep in mind …
    - You have hundreds of thousands of data sets
    - They are cataloged across 20-50 catalogs
    - Yet the majority of your data sets could be cataloged in as few as 2-3 catalogs
    - An unplanned outage or catastrophic failure of one catalog could result in significant downtime for critical business applications

Recognize Your Risks

	# Data Sets	% of Total	Cumulative %	# Aliases
SYS1.USR2.DEV.CATALOG	683,027	43%	43%	51
SYS1.TST1.DEV.CATALOG	274,644	17%	60%	293
SYS1.TST3.DEV.CATALOG	193,212	12%	72%	222
SYS1.PRD1.DEV.CATALOG	118,877	8%	80%	665
SYS1.DBNT.DEV.CATALOG	84,756	5%	85%	78
SYS1.DBTD.DEV.CATALOG	65,727	4%	89%	206
SYS1.DEV.PXCJ	39,841	3%	92%	11
SYS1.TST2.DEV.CATALOG	35,037	2%	94%	230
SYS1.GRP.DEV.CATALOG	30,174	2%	96%	33
SYS1.ENV.DEV.CATALOG	29,173	2%	98%	15
SYS1.USR4.DEV.CATALOG	10,336	1%	. . .	2,898
SYS1.USR3.DEV.CATALOG	7,242	1%	. . .	1,807
SYS1.USR1.DEV.CATALOG	6,484	<1%	. . .	980
SYS1.DRD.CATALOG	2,099	<1%		23
SYS1.DFHSM.DEV.CATALOG	1,595	<1%		1
SYS1.CADISK1.DEV.CATALOG	355	<1%		3
SYS1.LOGR.DEV.CATALOG	187	<1%		5
SYS1.DEV.CPYCROSS	137	<1%		1
SYS1.PLEX.DEV.CATALOG	48	<1%		2
SYS1.DISK2.DEV.CATALOG	5	<1%		2

Number of catalogs:	20
Total data sets:	1,582,956
Avg data sets/catalog:	79,148
Number of aliases:	7,526

Largest Catalogs	Top 2	Top 5
Total data sets:	957,671	1,354,516
% of total data sets:	60%	85%
Total aliases:	344	1,309

And This Isn't Unique

	Total Data Sets	Number of Catalogs	Largest Catalog	Top 5 Catalogs
Commercial Bank	3,241,000	22	2,913,000 89%	3,239,000 99%
Investment Bank	2,358,000	40	759,000 32%	1,658,000 70%
Insurance Company	1,500,000	68	438,000 38%	1,200,000 80%
Pharmaceutical Company	386,000	28	259,000 67%	355,000 92%
Pharmaceutical Company	575,000	8	398,000 69%	553,000 96%
Commercial Bank	2,368,000	34	1,054,000 39%	2,007,000 74%

Availability is Key

- Remember…
  - All of your data is cataloged
  - Your data requires 24x7 access
  - Downtime from failure can affect critical business applications
  - ICF catalogs (BCS and VVDS) failures don't happen often, but when they do, major outages often result
  - Regular diagnostics and day-to-day maintenance and management reduce risk of damage or outage
  - Scheduled maintenance can also affect availability

Improving Availability

- Tivoli Advanced Catalog Management supports high application availability
  - Rapid, reliable backup of catalogs supports backing up catalogs more frequently
  - Diagnostic commands create fixes to resolve problems found
  - Easy to use forward recovery process enables simplified and fast recovery
  - Reorganize and repair catalogs while they are open
  - Split and merge catalog entries while data sets are open
  - Real-time monitoring of catalog health through the Tivoli Enterprise Portal
  - Disaster recovery support enables rapid application availability

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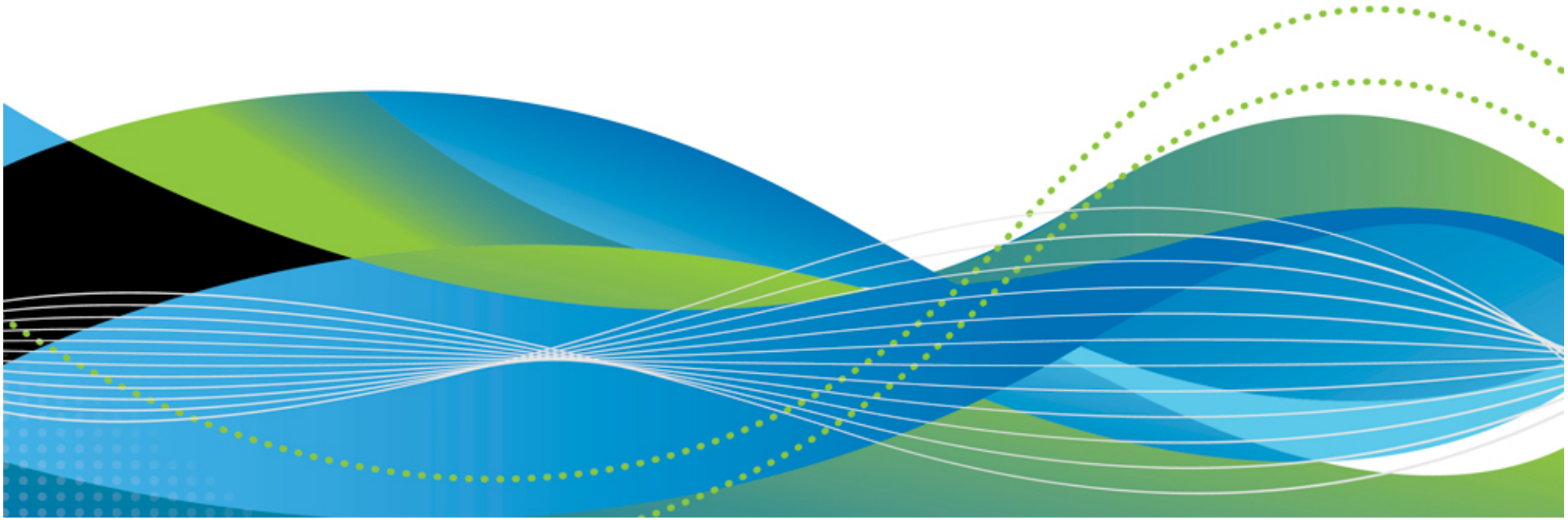
Catalog Backup



Catalog Backup

- Backup with Advanced Catalog Management
  - Can back up a BCS with a broken index or a damaged self-describing record
  - Directly accesses the data component of the KSDS to read data
    - Ensures all data is backed up even if the index is damaged
  - Backs up aliases from the master catalog
  - Backs up BCS definition parameters
  - Much faster run time than IDCAMS EXPORT
  - Can back up many or all BCSs in one command invocation using name masking

Catalog Backup

- Simplifying and Improving Backup Processing
  - Ensure all BCSs are being backed up by using name masking
    - Back up the master catalog and all connected user catalogs with one command
  - Rapid backup capability makes it practical to take backups more frequently
  - Easy to create multiple backup copies
  - The detailed return code summary makes it easy to identify where a problem occurred
  - Multi-tasking option for backups can further reduce execution time

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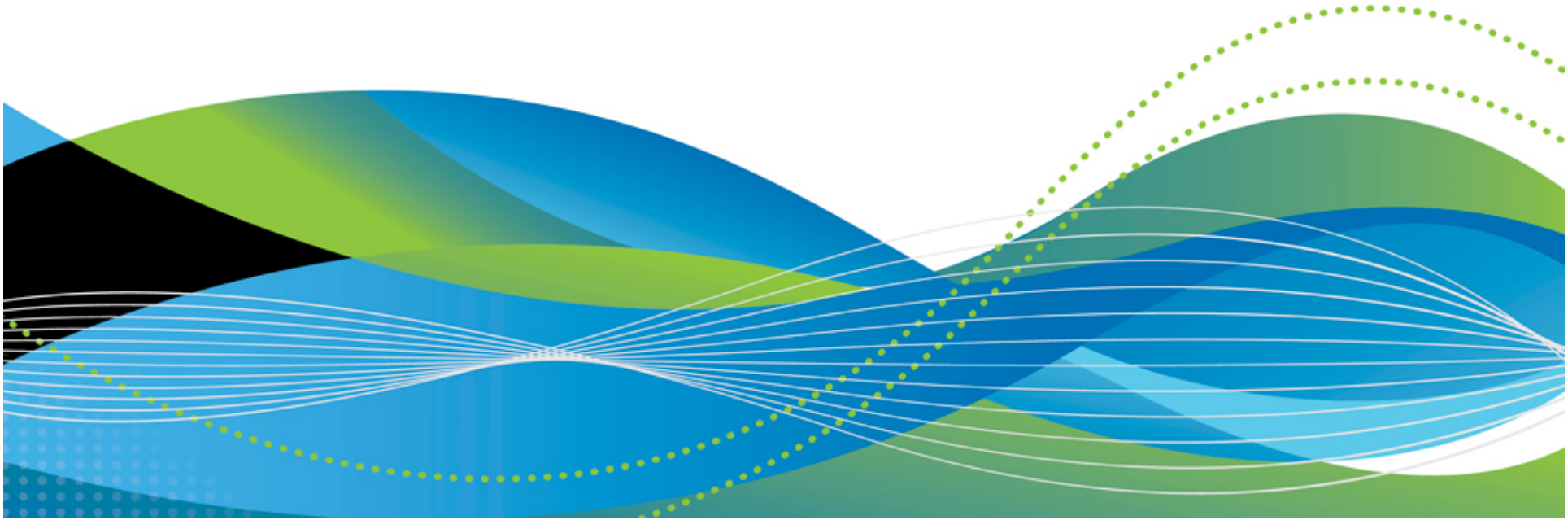
Catalog Diagnostics



Catalog Diagnostics

- Diagnostics with Advanced Catalog Management
  - Two unique options for diagnostics
    - Invoke IDCAMS EXAMINE and DIAGNOSE to verify structural integrity of catalogs
      - *Data set name masking eliminates requirement to manually code each catalog in a separate invocation of EXAMINE or DIAGNOSE*
      - *Return code summary table facilitates identifying catalogs with errors*
    - Customized diagnostic commands to analyze within BCSs, between BCSs and volumes (VVDSs and VTOCs), between BCSs and the tape management database, and master catalog aliases
      - *Provides detailed report of problems identified*
      - *Generates fixes to correct problems found*

Catalog Diagnostics

- Customized Diagnostics
  - Diagnostic commands verify data set entries on catalogs exist on DASD and that data sets on DASD are cataloged
  - Extensive diagnostics between VTOC and VVDS to identify any orphan components
  - Thorough multi-volume data set analysis
  - Analysis of master catalog aliases to determine if they are in sync with each other
  - Identification of empty aliases and user catalogs without any aliases associated to them
  - Diagnostic to check tape management database pointers towards BCSs to identify uncataloged tapes

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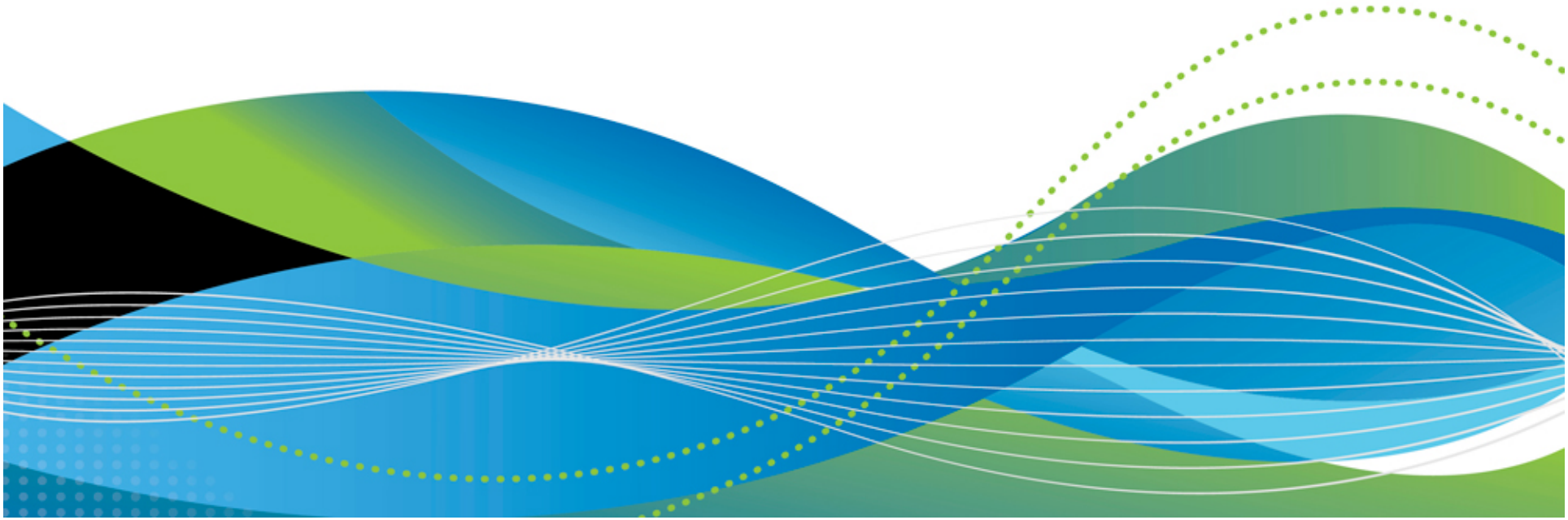
Catalog Recovery



Catalog Recovery

- A Catastrophic Catalog Failure Can Be Caused By:
  - Structural damage due to software or hardware failure
  - Human error
  - Application error
- Catastrophic Failure Requires BCS Forward Recovery
  - If a catalog should become corrupted and inaccessible, forward recovery with SMF data is required to restore full access
  - Options for performing recovery:
    - ICFRU and IDCAMS
    - Tivoli Advanced Catalog Management for z/OS

Catalog Recovery

- Forward Recovery Process with ICFRU and IDCAMS
  - Gather the SMF records from all systems sharing access to the catalog
  - Execute the CRURRSV component of ICFRU with the SMF data as input to extract the appropriate SMF records
  - Execute the CRURRAP component of ICFRU with the extracted SMF records from CRURRSV along with an IDCAMS EXPORT format backup of the catalog to create a new, updated EXPORT format backup
  - Execute IDCAMS DELETE and DEFINE for the catalog
  - Execute IDCAMS IMPORT to load the catalog from the EXPORT format backup created by CRURRAP

Catalog Recovery

- Forward Recovery with Advanced Catalog Management
  - Gather the SMF records from all systems sharing access to the catalog
  - Execute the RECOVER command providing an Advanced Catalog Management format backup or an IDCAMS EXPORT format backup and the SMF data as input to create a new, updated catalog ready for use

➢ Note: Advanced Catalog Management provides a simulation option to allow advanced testing and error correction of all recovery commands

Catalog Recovery

- About Forward Recovery with Advanced Catalog Management
  - Reduces application outage time in the event of a catalog failure
  - Simulation capability allows advance testing and error correction
    - Reduces the time required to set up the recovery job when a catalog failure occurs
  - Delete and redefine of the BCS done automatically
    - No manual delete and define of the BCS required
  - Automatically removes the IMBED or REPLICATE attributes if found to be present

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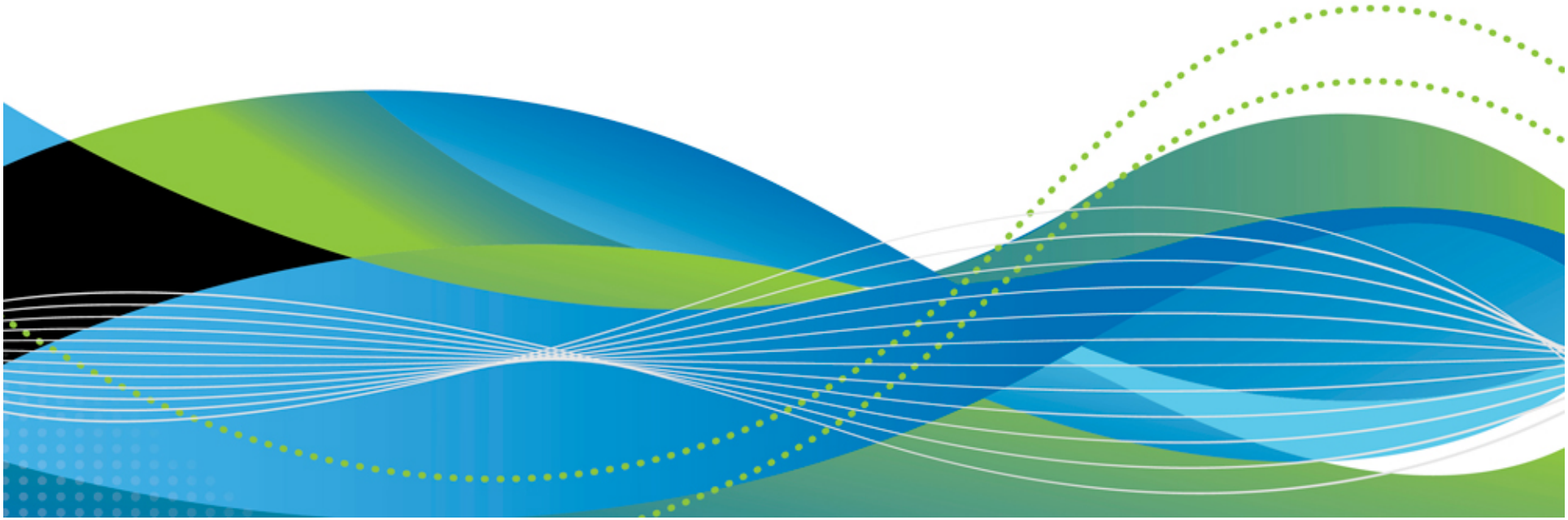
Catalog Reorganization



Catalog Reorganization

- When Should A Catalog Be Reorganized?
  - When it has grown to a large number of extents
  - When there has been a large amount of deletion activity against the catalog
    - Mass deletions
    - Removal of many entries to another catalog as a result of splitting the catalog
  - If the catalog resides on a volume where:
    - There is not enough room to take additional extents *and*
    - There are no other data sets that can be moved off of the volume to provide additional space *and*
    - Reclamation of space through reorganization will help

Catalog Reorganization

- Reorganization with Advanced Catalog Management
  - Eliminates the need to take business applications out of service to perform routine catalog maintenance
  - Simulation capability allows advance testing and error correction
  - Options are available to increase the space of the BCS, release unused extents, or move the BCS to another volume
  - BCS structural errors found during processing can be repaired
  - Automatically removes the IMBED or REPLICATE attributes if found to be present

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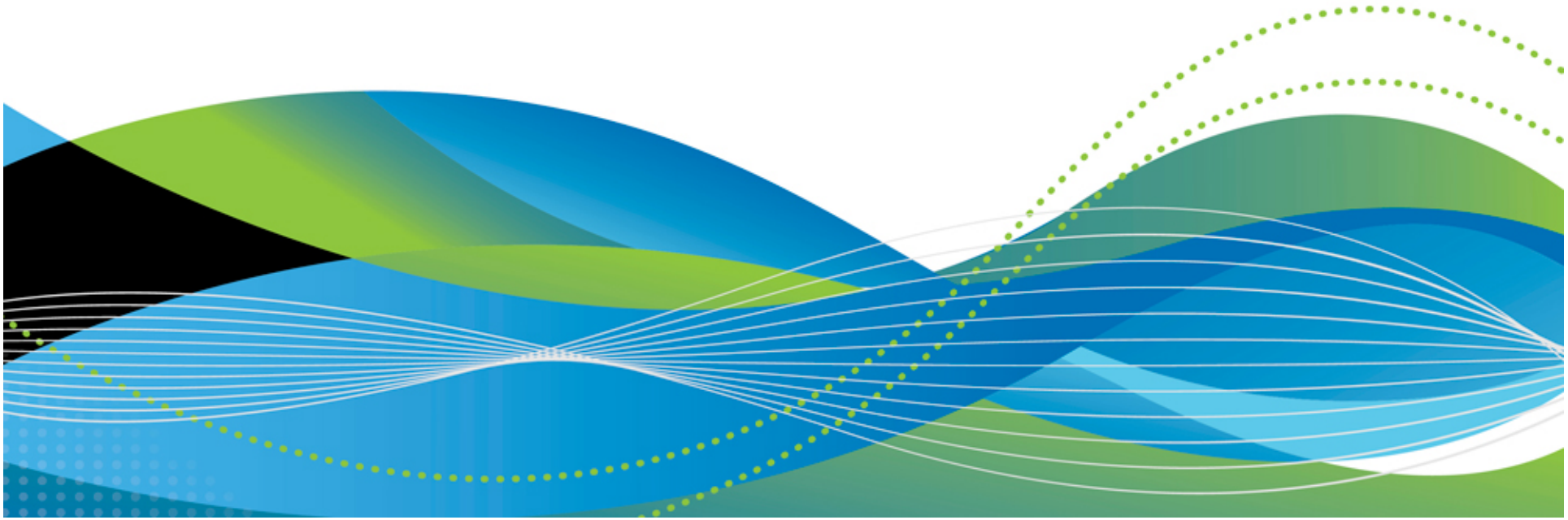
Splitting and Merging Catalogs



Catalog Split/Merge

- Why Should Entries in a Catalog Be Split or Merged?
  - When the data sets for multiple critical business applications are all cataloged in a single catalog
  - When the size of the BCS becomes very large
  - When the number of entries in a BCS is very high
  - When related applications are spread across several catalogs
  - When mergers and acquisitions occur and data must be combined
  - When business divestitures occur and data must be divided

Catalog Split/Merge

- Business Application Outages
  - Catalog split or merge tasks typically require business application outages
- Split/Merge with Advanced Catalog Management
  - Processes catalog entries where data sets are open to move them non-disruptively from one catalog to another
    - No business application outage is required!

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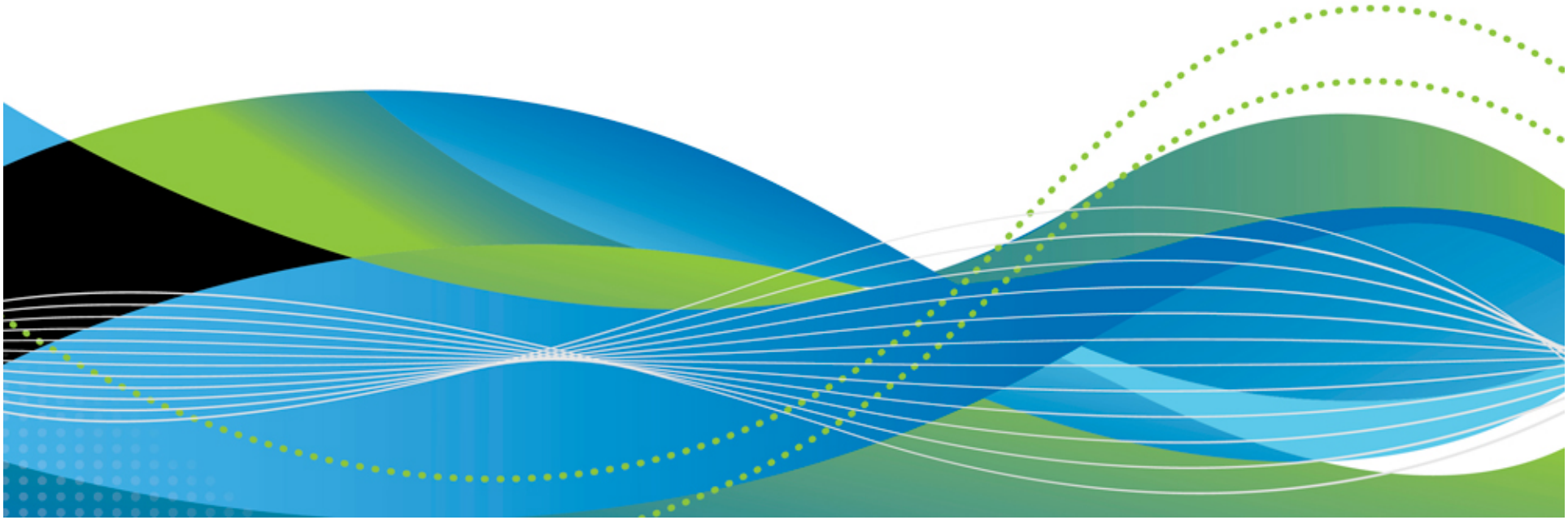
Monitoring Catalog Health



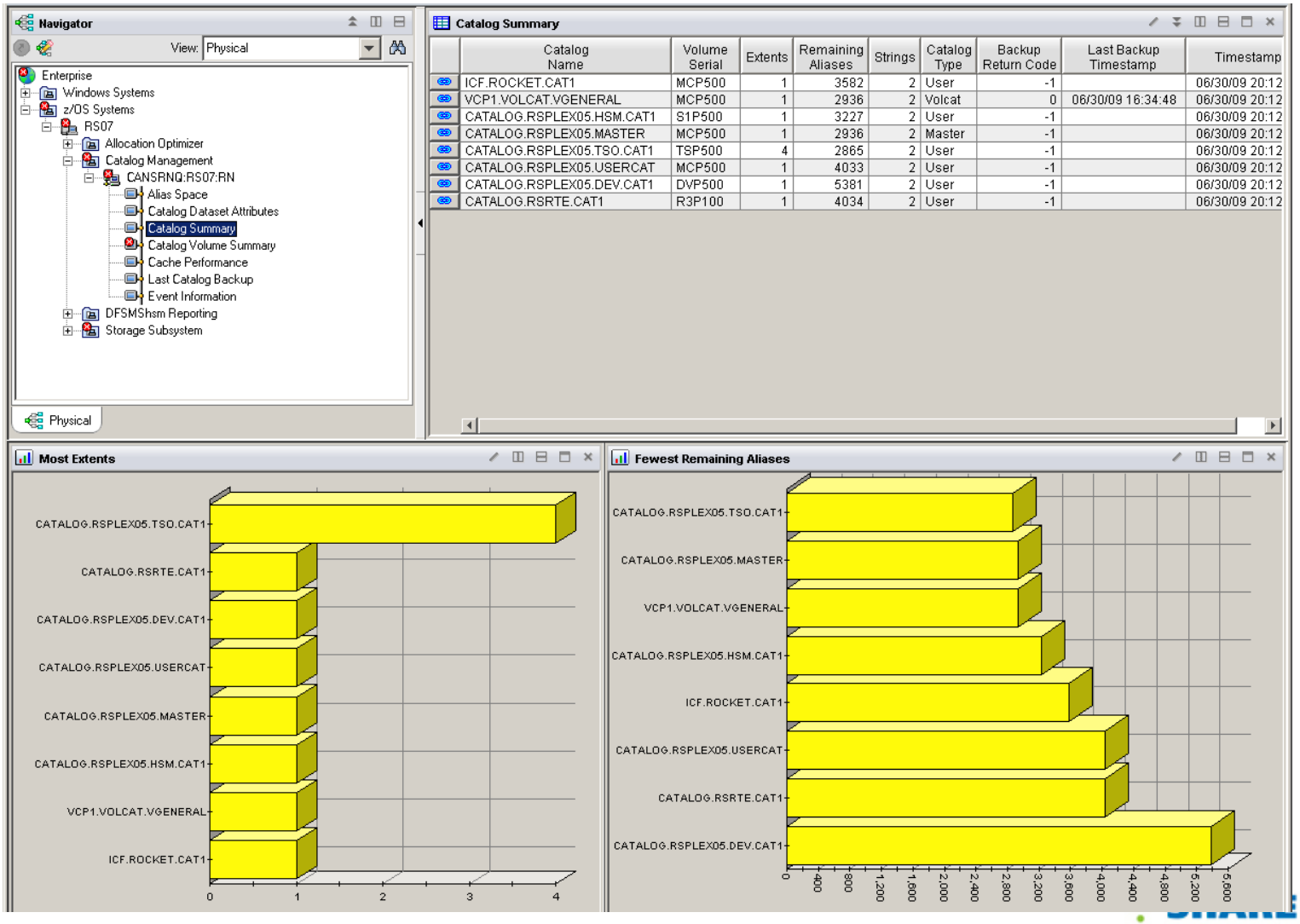
Tivoli Enterprise Portal (TEP)

- TEP Provides the Central User Interface for IBM Monitoring and Management Solutions
  - Links key facets of System z Storage Management together
  - Provides built-in tools to capture expert knowledge
    - Reduces reliance on technical “gurus”
  - Makes it much easier to detect, diagnose and correct problems

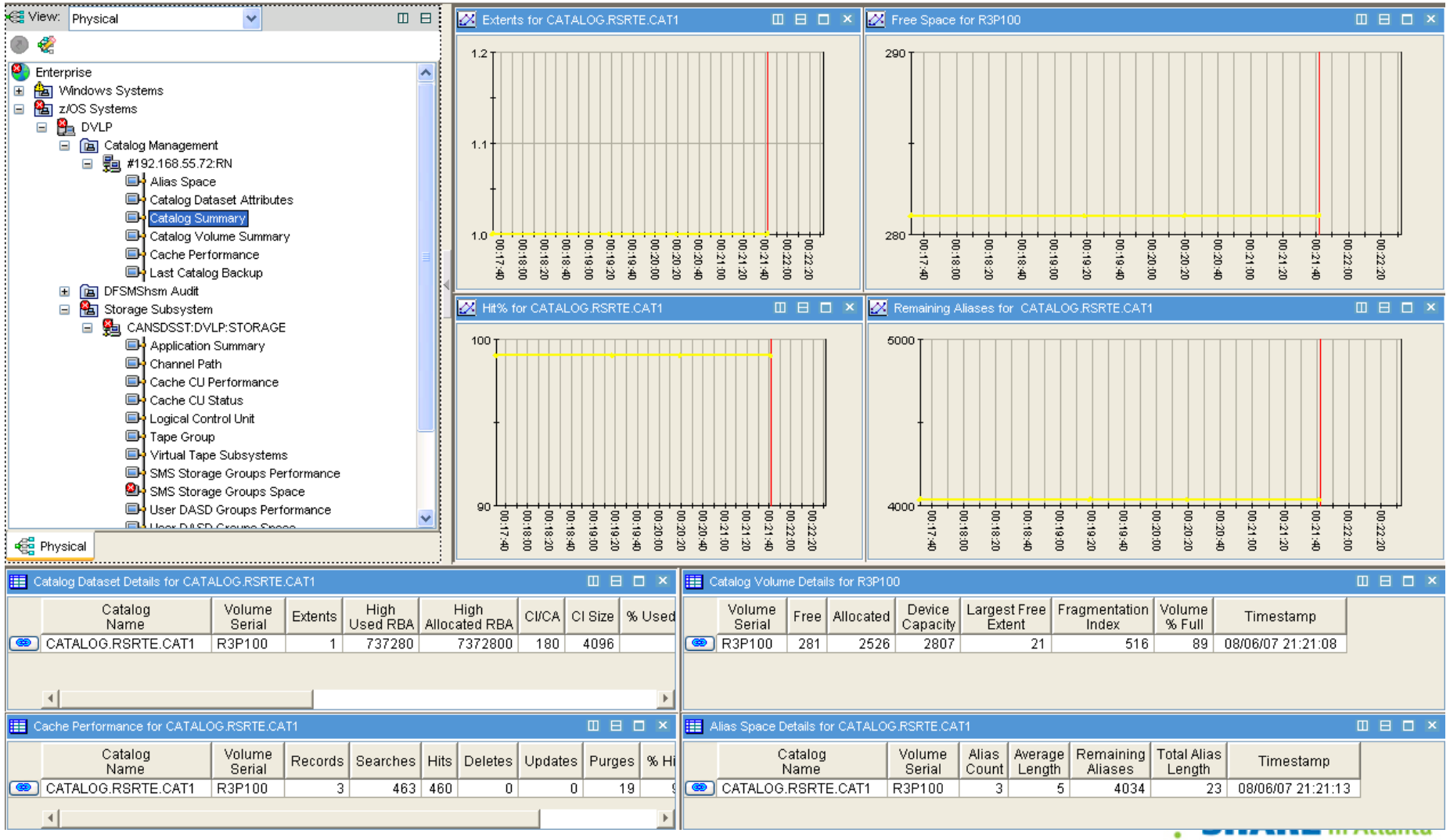
Advanced Catalog Management and TEP

- Advanced Catalog Management is TEP Enabled
  - Centralized, real-time viewing of catalog health:
    - Number of BCS extents taken
    - Amount of available space on the volume for extents
    - Alias count nearing the maximum
    - Display CAS statistics
    - Display return codes from catalog backups taken
    - View catalog data set attributes
  - Situations provided that monitor thresholds for out of space conditions
  - Actions available to submit diagnostic jobs, send email notifications or WTO messages for automation management

An Overview of Key Catalog Information



Drill Down to Get Details



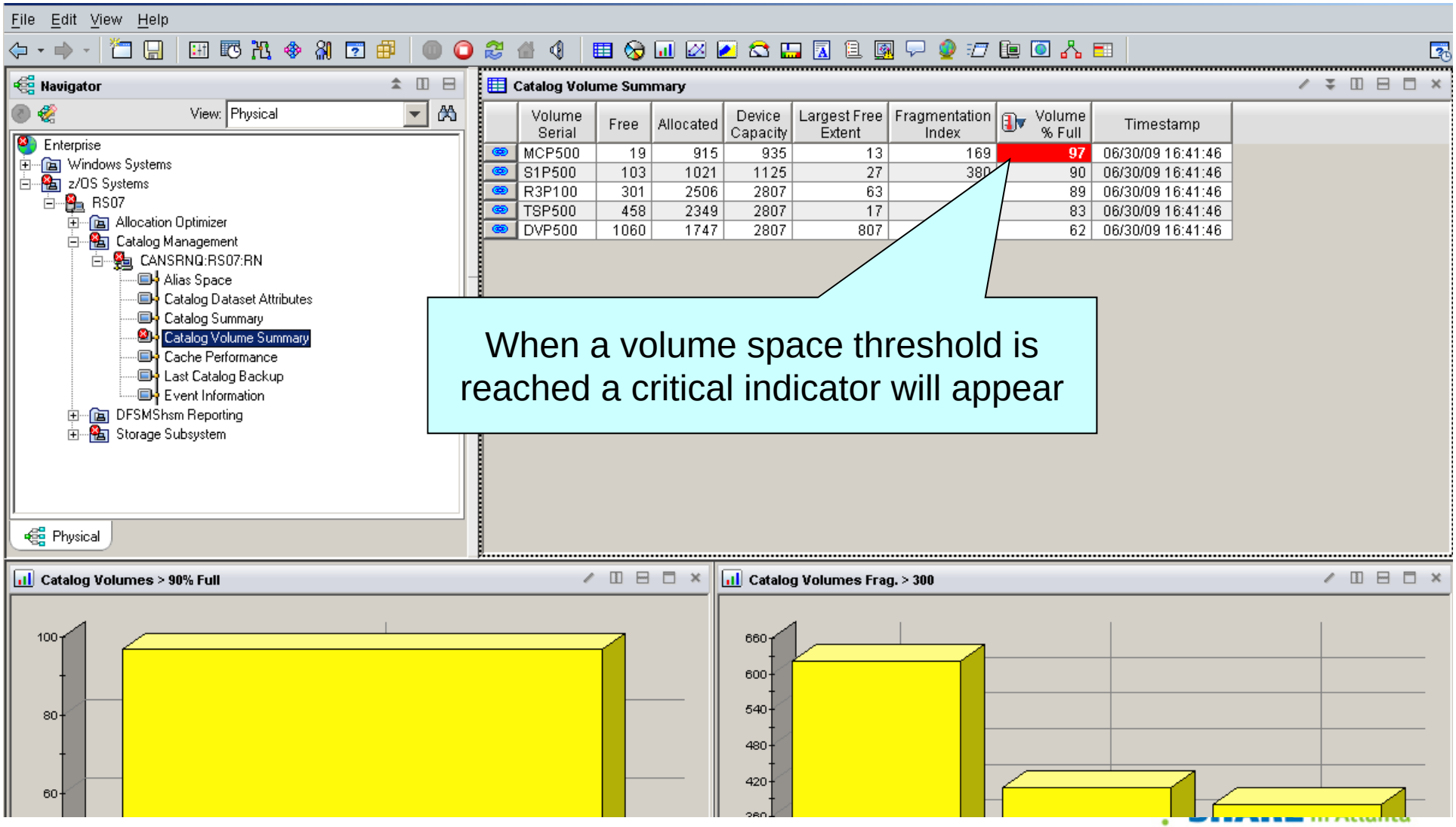
Increasing Catalog Availability with TEP

- TEP Monitors Specific Catalog Related Situations
  - If a threshold for a situation is met or exceeded, an indicator will note the level
    - Yellow for warning thresholds
    - Red for critical thresholds
  - Actions can be requested to resolve certain problems
    - Three types of actions available:
      - *Send an email notification of the problem*
      - *Run a batch job*
      - *Send a WTO to the console so that an automated action can take place*

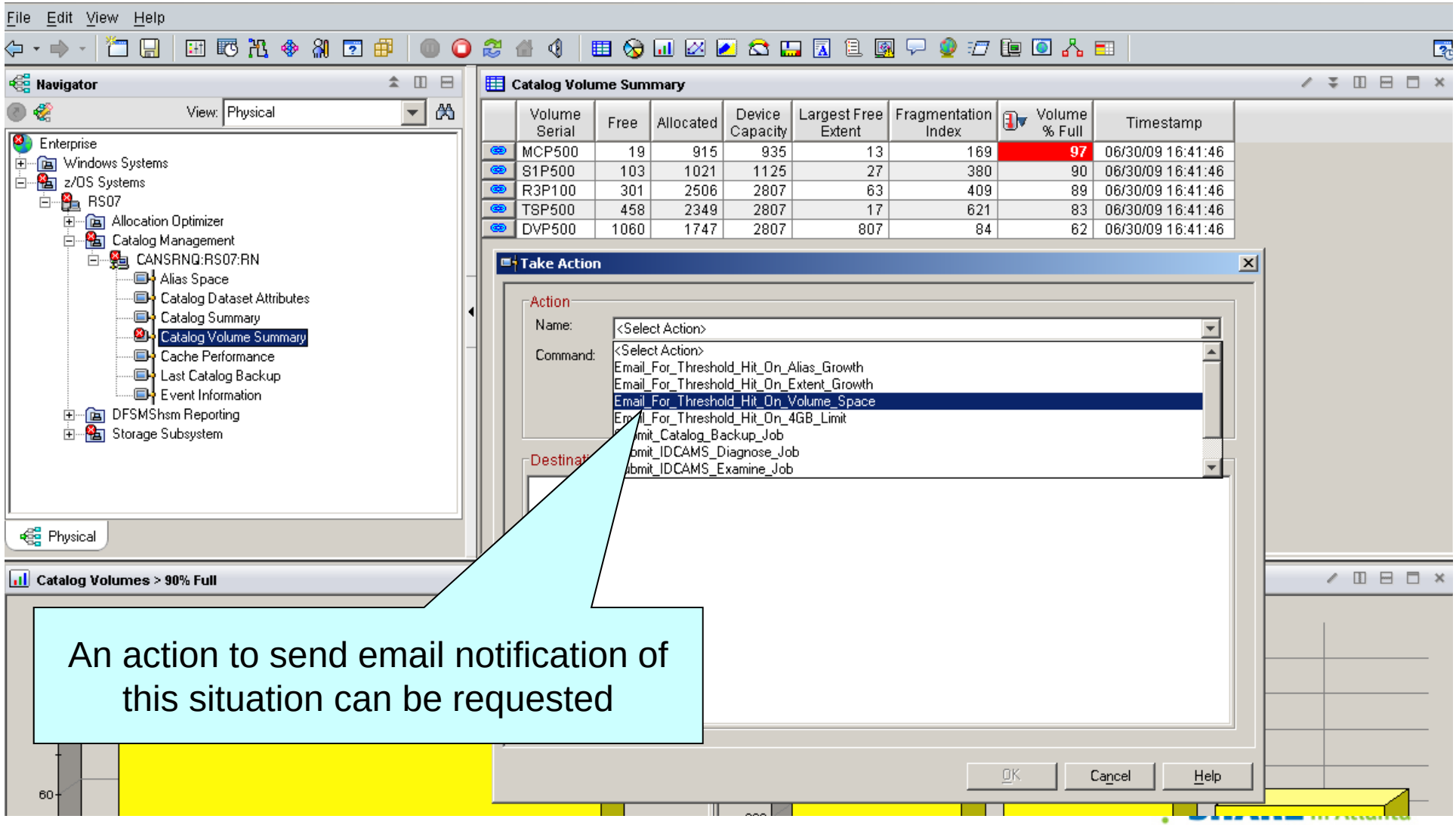
Actions Available

- These Actions Are Available in the TEP
  - An email can be sent to a pre-defined set of users when a threshold is met for:
    - Number of BCS extents reached
    - Percentage of 4GB limit reached
    - Approximate number of aliases remaining
    - Lack of available space on volume
  - WTO messages for automation management can be issued when thresholds reached to:
    - Request a BCS reorganization when extents exceeded
    - Back up a BCS when prior backup failed
  - Batch job submission to perform IDCAMS EXAMINE or DIAGNOSE, or perform BCS backup

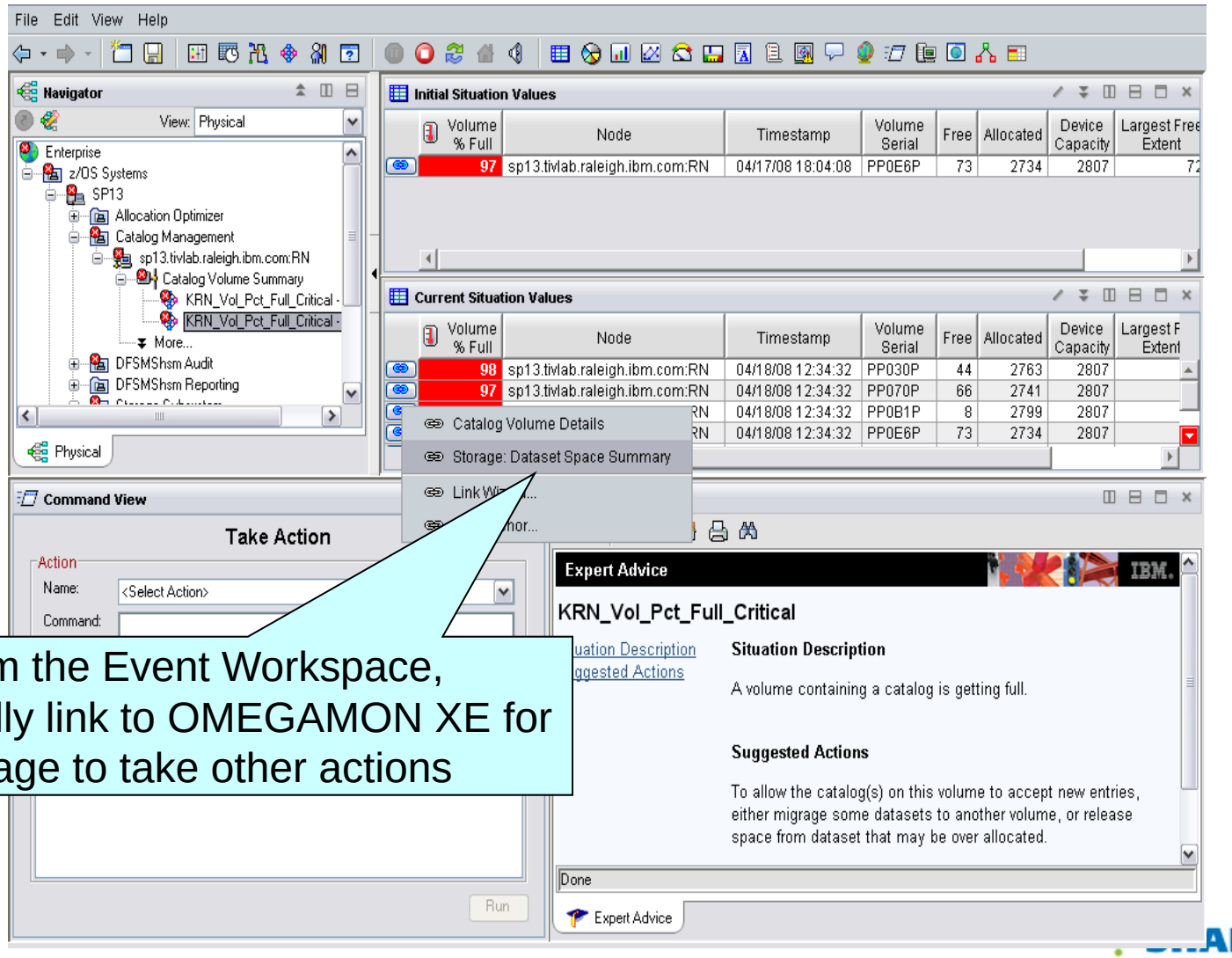
Shortage of Space on a Catalog Volume



Shortage of Space on a Catalog Volume

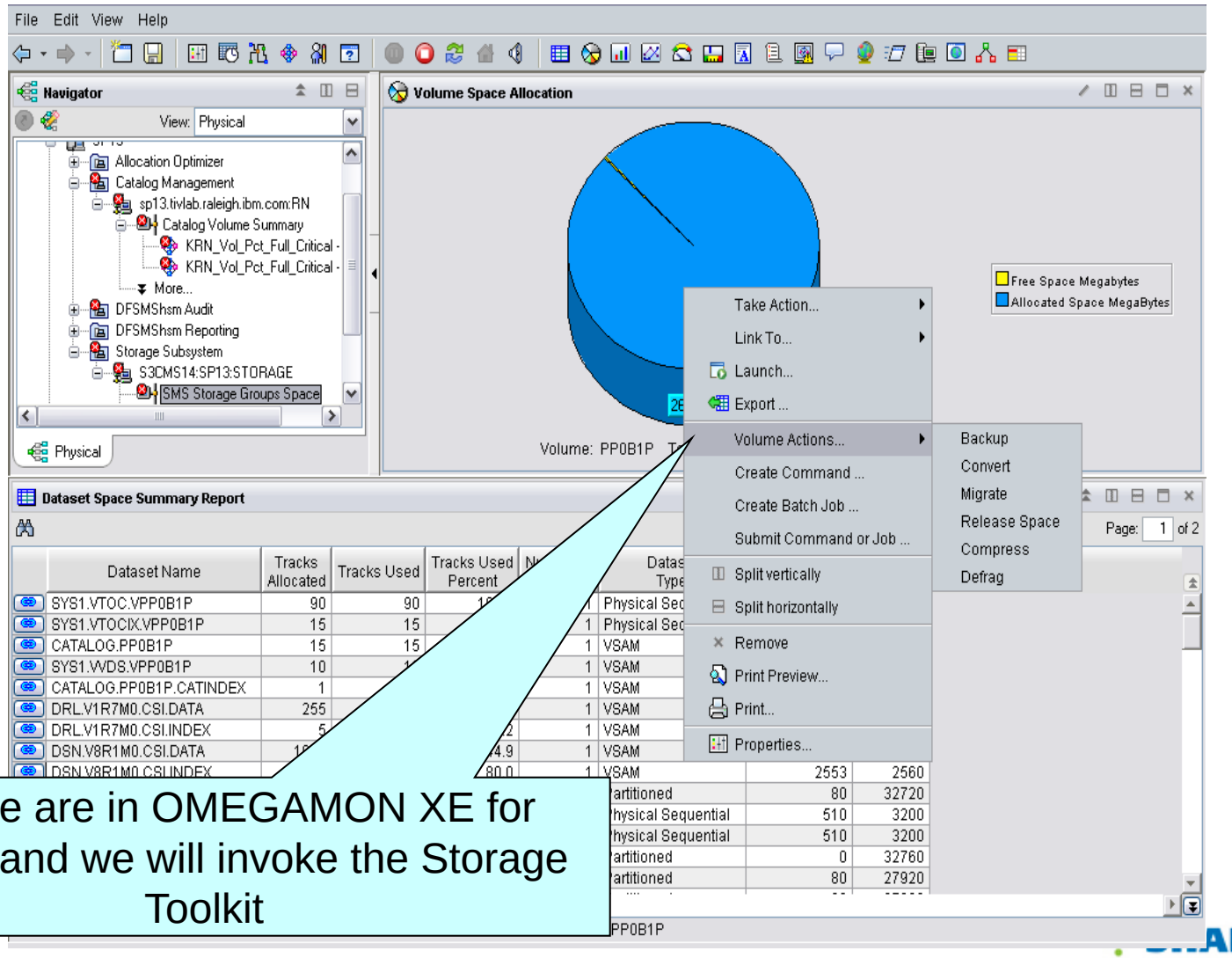


Shortage of Space on a Catalog Volume



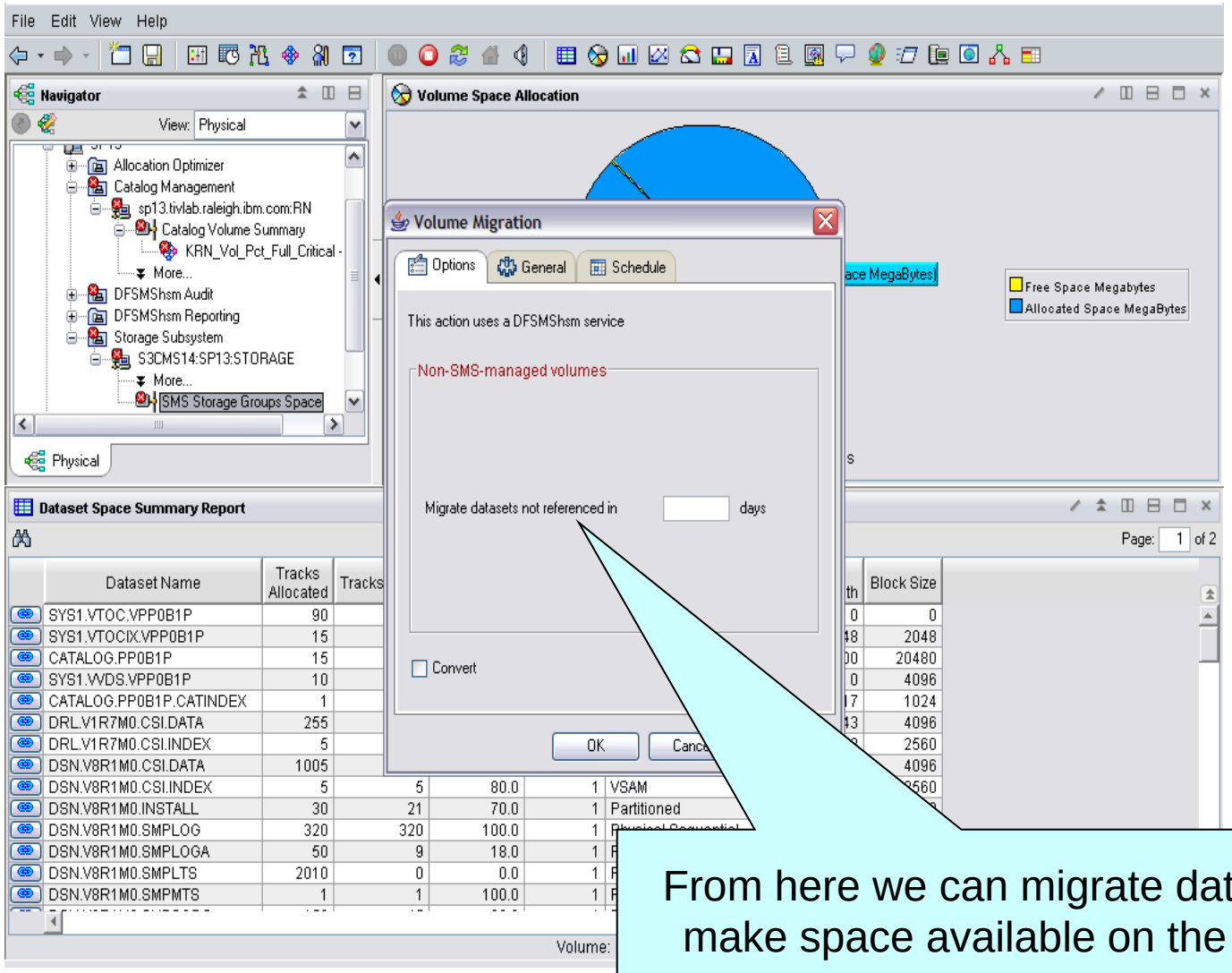
From the Event Workspace, dynamically link to OMEGAMON XE for Storage to take other actions

Shortage of Space on a Catalog Volume



Now we are in OMEGAMON XE for Storage and we will invoke the Storage Toolkit

Shortage of Space on a Catalog Volume



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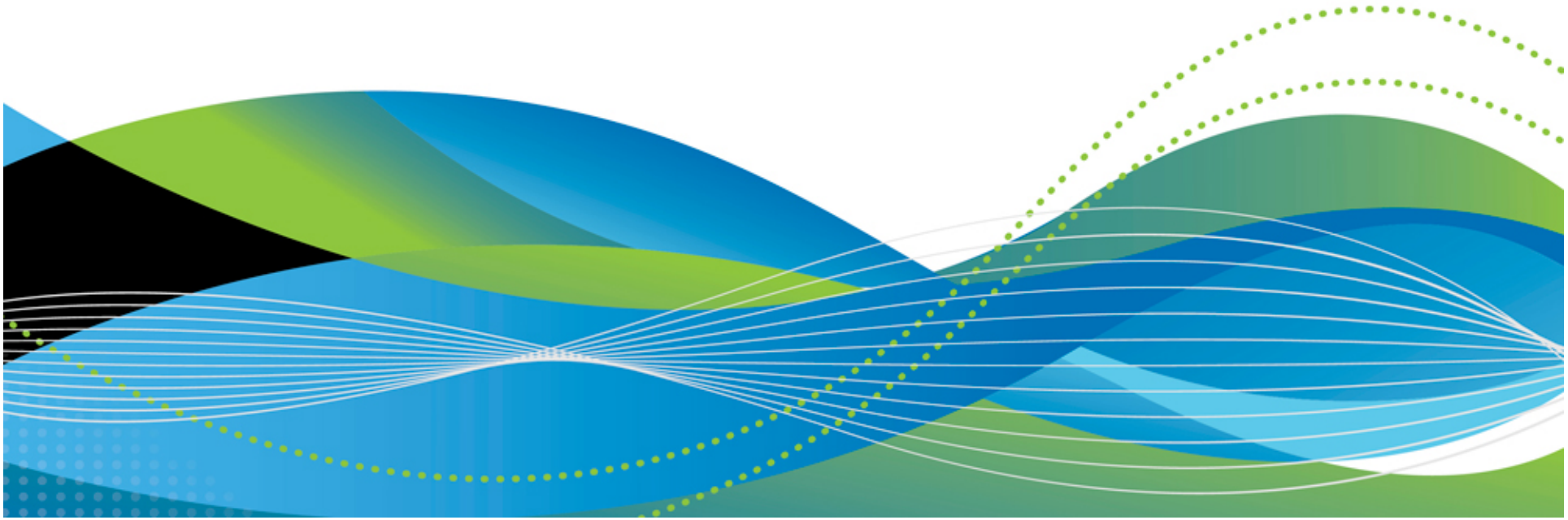
Disaster Recovery Support



Disaster Recovery Catalog Options

- What State Are Your Catalogs In?
  - Fully populated catalogs (“full”) recovered at the disaster recovery site through:
    - Full volume restore
    - Mirroring
    - Specific catalog recovery
  - Empty catalogs (“empty”) at the disaster recovery site:
    - Not part of the full volume restore or mirror
    - Redefined in an empty state

Disaster Recovery Catalog Options

- Working With Full Catalogs
  - Full catalogs are most useful when they contain entries for system data sets
  - Usually have full volumes as a result of full volume restore or mirroring
- Working With Empty Catalogs
  - Empty catalogs are most useful when they contain entries for application data recovered logically (not through full volume restore)
  - No synchronization issues because only the data sets recovered will be cataloged

Disaster Recovery Support

- Synchronizing Catalogs Using Advanced Catalog Management
  - Each record is compared in the specified catalogs against the actual data sets on the online DASD
    - If the catalog record doesn't match up with a DASD data set, the catalog record is deleted
    - The records are deleted directly from the BCS without invoking IDCAMS
      - *Results in extremely fast processing*
    - A report is provided detailing the actions taken

Disaster Recovery Support

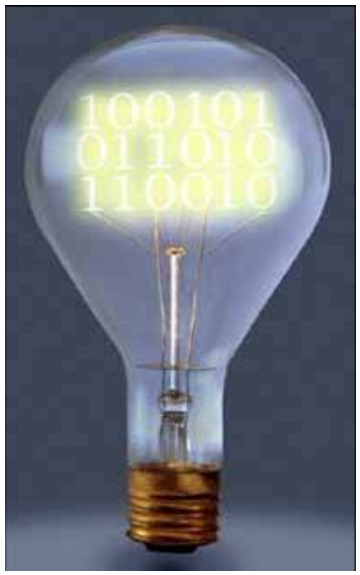
- Advanced Catalog Management
  - Matches catalog entries to data sets on the online volumes at disaster recovery
  - Can control other types of entries
    - Migrated data sets
    - Tape data sets
    - GDS not found on volume
    - GDG base without active generations
    - Specific data set names
    - Specific volume serials
  - A simulation option allows for advance testing and error correction

Disaster Recovery Support

- Creating Empty or Partially Empty Catalogs with Advanced Catalog Management
  - Redefine the catalog structure
  - Define the aliases in the master catalog
  - Recover selected entries by:
    - Data set name
    - Volume serial
    - Data set type
      - *GDG bases and GDS entries*
      - *Empty GDG bases*
      - *Tape data sets or VOLCAT entries*
      - *Non-VSAM or VSAM data sets*
  - Use full or masked names for data sets or volumes

Summary

- Tivoli Advanced Catalog Management for z/OS offers:
  - Rapid ICF catalog backup
  - One-step forward recovery
  - Extensive diagnosis and repair facilities
  - Reorganize and repair BCSs while open
  - Move BCS entries while data sets are in use
  - Enhanced functionality available through the ISPF and TEP interfaces



Conclusion

- Tivoli Advanced Catalog Management for z/OS simplifies catalog management tasks:
  - Fewer steps to execute for many tasks
  - Faster execution time than other options
  - Automated error correction for problems identified
  - Reduces outage time required for catalog maintenance

For More Information

- *z/OS DFSMS Access Method Services for Catalogs* – SC26-7394
- *z/OS DFSMS: Managing Catalogs* – SC26-7409
- *IBM Tivoli Advanced Catalog Management for z/OS User's Guide, V2.4* – SC23-9816
- *ICF Catalog Backup and Recovery: A Practical Guide* – IBM Redbook SG24-5644

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