Evolution of an Intelligent ILM Offering

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The quest for Information Lifecycle Management (ILM) has been a lengthy one. This presentation explores products and services which have evolved as the underpinnings of ILM solutions: Storage Virtualization, Storage Management, and increasingly Intelligent ILM for Block Storage.

- Early solutions focused on tiered storage and simple rules implemented in scripts or batch processing jobs.
- Research technologies further integrate analytics and performance history.

More recent implementations of ILM Solutions based on creation of “intelligent” sense and respond techniques using automation and analytics, starting with Block Storage based ILM.

- Review IBM’s integration of Research Analytics and Automation tools with Fibre Channel Virtualization via SAN Volume Controller (SVC) and Storage Management Services via Tivoli Storage Productivity Center (TPC).
- Key technologies: Classification technologies and offerings.
- Intelligent ILM Pilot offering builds on current products and leverages method based evolution of both storage services and storage software and hardware technologies.

End result: Reduced overall storage costs & improved storage utilization.
- Results are presented from integration of Intelligent ILM into production Services Offering.

Demonstrations: integration of IBM Research components into an Intelligent ILM offering leveraging TPC and SVC products.
Agenda: Evolution of Intelligent ILM

- **Part 1 – Introduction**
  - Context for Storage ILM Solutions
  - Repeatable, Requirements based Method in Storage Solutions
  - Criteria for Tiering in Storage ILM
  - Core products and offerings summarized

- **Part 2 – Current Storage ILM Implementation Components**
  - Storage Resource Manager – Tivoli Storage Productivity Center
  - Storage Virtualization Manager – SAN Volume Controller
  - Data Classification based on Application Requirements - ISSC
  - ISTM (Sage) – the tiering manager
  - ISPM (Spark) – the placement manager

- **Part 3 – Putting the pieces together: an Intelligent ILM Pilot Offering**

- **Part 4 – Demonstrations**
  - IBM AlmadenResearch Demonstrations of Pilot Intelligent ILM components
Part 1
Introduction
Introduction: Storage and ILM

- Storage ILM in context
  - Storage Tiering and Hierarchical Storage Management (HSM) have added classification and automation to become Storage Information Lifecycle Management (ILM)

- This presentation summarizes the technology behind the IBM GTS Pilot Offering of an Intelligent ILM Block Storage service
  - Summary of the customer requirements that drove the IBM Research and GTS Offering teams to develop this Intelligent ILM service
  - A brief introduction of the core product technologies that are fundamental to implementing an Intelligent ILM service
  - How this stack of software and hardware components work together
  - Demonstration of major Use Cases for the Intelligent ILM service
  - The technologies, services, and offerings documented here include Pilot technologies that may not become part of products or service offerings.
How Requirements Drive Intelligent ILM

- Customer requirements that drive the evolution of Intelligent ILM
  - Block Storage Volume demand that exceeds budgets allocated to Storage
  - Realization that much of the higher cost storage is not efficiently used but lack quantification of how inefficiently storage is used
  - When Strategic Outsourcing customers brought these requirements en masse, Services groups responded and coordinated solution efforts across IBM

- How does IBM respond to Customer Storage requirements for Intelligent ILM?
  - Storage Product teams (STG & SWG) are constantly refining products based on customer requirements
  - Global Services teams also refine offerings and services, the Services team counterpart to STG and SWG products
  - Research Division applied innovation teams investigate novel extensions to products and services to meet customer requirements

- The combined efforts of Storage Product teams, Global Technology Services and IBM Research developed the Pilot Intelligent ILM Offering
ILM and Classification Criteria (1)

“Information Lifecycle Management (ILM) is a process for managing information through its lifecycle, from conception until disposal, in a manner that optimizes storage and access.”

70% of data hasn’t been accessed in 90 days or more [Gartner]

Goal: “Place the right data on the right storage at the right time” [EDGE-JC1]
ILM and Classification Criteria (2)

- Capture the *value* of data and its appropriateness for a tier of storage

![Graph showing relative value of data over time](graph.png)

Source of graph: IBM Enterprise Storage Group

**Types of policies**

- **Placement policies**: (e.g. place volumes for application group A on tier3)
- **Migration policies**: (e.g. migrate volumes down-tier if low activity detected)
- **Deletion policies**: (e.g. delete volumes older than 30 days of application group A that are not mapped to a host)
- **Archival and Backup policies**: (e.g. move volumes/files into TSM storage pools, including tape)

[EDGE-JC1]
As storage consumption and resultant costs grow, chief information officers seek ways to cut costs through transformation.

As information loses value over time, it should be moved to the most cost-effective resources.

[EDGE-LR1]

Source: IBM Global Technology Services estimates
Part 2
Current Storage ILM Implementation
Current Storage ILM Components

- Storage Virtualization
  - SAN Volume Controller (SVC)

- Storage Resource Management
  - Tivoli Storage Productivity Center (TPC)

- Classification based on Application Requirements and History
  - Intelligent Storage Services Catalog (ISSC)

- Research extensions
  - Model based Classification based on rules and analytics:
    Intelligent Storage Placement Manager (ISPM, aka Spark)
  - Automated Provisioning using policies from above:
    Intelligent Storage Tiering Manager (ISTM, aka Sage)
Current Storage ILM Components (1)

- Application (Data Originator)
  - Data Mgmt
  - Data Classifier

- Delivery Services
  - Staff Web Svcs
  - Staff Customer Services

- ISSC Engagement (opt)
  - Data Types & Requirements
  - Services & Technologies
  - New Storage Req Process

- Storage Servers (ex: DS8k, V7000, XIV)
  - Block Copy Services
  - Stor Server
    - Tier 0
    - Tier 1
    - Tier N

- Data Mapping/Mgmt Srv
  - ISTM Sage
  - Tiering Manager
  - ISPM Spark
  - Placement Manager

- SAN Management
  - SAN Switches
  - SVC

Optional Services
- Migr Factory, et al

Reporting Services
- Reporting Server

MSmith IBM GTS SSA  2012-07-30
Current Storage ILM Components (2)

![Diagram showing Current Storage ILM Components](image)
Current Storage ILM Components (3)
Current Storage ILM Components (4)

- ISSC Offering: an assessment engagement that creates policies for input to Intelligent ILM
Current Storage ILM Components (5)

- Intelligent Storage Tiering Manager (Sage)
  - Provides two core functions:
    - calculating the value of data and
    - moving data to the appropriate storage tier based on its calculated value
  - Data valuation is simplified through the use of customer created policies

- Intelligent Storage Placement Manager (Spark)
  - Dynamic Virtualization Management
  - Placement Analytics
  - Migration scheduling analytics using models and historical performance data from TPC
Part 3
A Pilot Intelligent ILM Offering
IBM Internal Results from the Intelligent ILM offering [EDGE-MS1]:

**The Scale of Computing at IBM**

- 92% servers virtualized in strategic hosting environments
- 1.2M MIPS across System z, p, x and i
- 1.9M annual Help Desk calls
- 92K annual changes
- 570K Notes seats
- 50M daily instant messages
- 110 petabytes of storage including production, development and back-up
- Endpoint Security Compliance for 850K workstations/mobile devices

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Intelligent ILM Pilot (2)

Current Internal Storage Profile

Backup and tape – 32 Petabytes
- Offline storage of data for recovery
- Used in data center and by end users
- Tiers available for offsite, LAN free, etc.
- Intended to be secondary copy of data

Block – 10 Petabytes
- Raw disk access inside data center
- Typically delivered over Fibre Channel SAN
- Device level access control
- No built in file structure

File - 1 Petabyte
- Used in data center and by end users
- Mapped drive letter or NFS file sys storage
- Files, directories, access control lists
- Typically delivered over IP network
- File storage logically includes block & backup

EDGE-MS1
Optimizing storage costs requires understanding the drivers of explosive storage growth ... and the levers we have to manage it.

<table>
<thead>
<tr>
<th>Factors <strong>Increasing</strong> Costs</th>
<th>Factors <strong>Decreasing</strong> Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Normal growth (historically 25%+ per year)</td>
<td>• Storage commoditization</td>
</tr>
<tr>
<td>• New demand</td>
<td>• Incremental technology improvements</td>
</tr>
<tr>
<td>• Increasing user population</td>
<td>• Supply management</td>
</tr>
<tr>
<td>• Smart devices</td>
<td>• Data compression and de-duplication</td>
</tr>
<tr>
<td>• Rich media (audio/video)</td>
<td>• Storage virtualization</td>
</tr>
<tr>
<td>• Social computing</td>
<td>• Thin provisioning</td>
</tr>
<tr>
<td>• Other influences</td>
<td>• Automated tiering and data migration</td>
</tr>
<tr>
<td>• Demands to reduce risk</td>
<td>• Archiving</td>
</tr>
<tr>
<td>• Growth in file size</td>
<td>• Demand management</td>
</tr>
<tr>
<td>• Data retention requirements</td>
<td>• Optimization</td>
</tr>
<tr>
<td></td>
<td>• Data retention and hygiene programs</td>
</tr>
</tbody>
</table>
Self Optimization Opportunity

Move data to the right place

- Block Storage Cloud
- Automated Provisioning
- Automated Tiering

Preliminary View – Boulder Data Center
IBM (internal) Boulder, Colorado Data Center

- Decrease reliance on Tier 1 storage by 10% over 3 years, saving an estimated $13 million
- Reduce complexity
- Key technologies
  - IBM SAN Volume Controller (SVC)
  - Tivoli Storage Productivity Center (TPC)
  - IBM storage tiering software (pilot)
New tools automate “right tiering”

Before

- DS8000
- XIV
- V7000/
  DS5000

Right-tiering

- Monitor data usage to **direct moves between tiers**
- **Move data** between storage tiers without disruption

[EDGE-MS1]
CIO “Right tiering” projection

- All projections reflect normal/expected per unit decreases in base hardware cost over time
- Reflects rolling adoption within and across geos

[EDGE-MS1]
Part 5
Intelligent ILM Demonstrations
Intelligent ILM Pilot Demonstrations

- ISTM (Sage) the Intelligent Storage Tiering Manager

[Screen captures follow that are excerpted from ISTM (Sage) demonstration]

Use Cases:

- Policy Set Creation
  - Scoping (To/From)
  - Conditions

- Policy Assessment
  - Types (Normal/Fast)
  - Capacity Utilization & Cost
  - Policy Effectiveness
  - Migrations & Subsystem Impact

- Real-world Policy Assessment
  - Storage Environment Summary
  - Policy Assessment
Intelligent ILM Pilot Demonstration

ISTM: Intelligent Storage Tiering Manager

View policy details by clicking on a policy
Intelligent ILM Pilot Demonstration

ISTM: Intelligent Storage Tiering Manager

New Policy

- **Name:** Tier 1 to 2
- **Unit:** Volume
- **Type:** Migration
- **From:** Tier1
- **To:** Tier2
- **Conditions:** Name

Add condition

Save  Cancel
Intelligent ILM Pilot Demonstration

ISTM: Intelligent Storage Tiering Manager

New Policy

Name: Tier 1 to 2
Unit: Volume
Type: Migration
From: Tier1
To: Tier2

Conditions: Name
Add condition

Save   Cancel
Intelligent ILM Pilot Demonstration

### ISTM: Intelligent Storage Tiering Manager

**Policies**
- Preview

**New Policy**
- **Name:** Tier 1 to 2
- **Unit:** Volume
- **Type:** Migration
- **From:** Tier1
- **To:** Tier2
- **Datatype:** MDGs

**MDGs**
- List: DRPlanMDG_reef, managedMDG (SVC), POOL6DS8K (SVC), POOL7DS8K (SVC), POOL6DS8K (SVC), POOL7DS8K (SVC), POOL8DS8K (SVC), POOL8DS8K (SVC)

**Conditions:**
- Name

**Options:**
- Add
- Edit
- Delete

**Save** **Cancel**
Intelligent ILM Pilot Demonstration

ISTM: Intelligent Storage Tiering Manager

New Policy:
- **Name**: Tier 1 to 2
- **Unit**: Volume
- **Type**: Migration
- **From**: Tier 1
- **To**: Tier 2
- **Conditions**: Name

Options:
- Save
- Cancel
Intelligent ILM Pilot Demonstration

ISTM: Intelligent Storage Tiering Manager

New Policy
- **Name:** Tier 1 to 2
- **Unit:** Volume
- **Type:** Migration
- **From:** Tier1
  - All MDGs, SRCs, SSs, Hosts
  - Virtuals
  - Exclude Hosts
- **To:** Tier2
  - All MDGs, SRCs, SSs
- **Conditions:** `name`
  - `server1_`
Intelligent ILM Pilot Demonstration

ISTM: Intelligent Storage Tiering Manager

New Policy

Name: Tier 1 to 2
Unit: Volume
Type: Migration
From: Tier1
To: Tier2
Conditions: Name

Save  Cancel
Intelligent ILM Pilot Demonstrations

ISTM: Intelligent Storage Tiering Manager

New Policy

- Name: Tier 1 to 2
- Unit: Volume
- Type: Migration
- From: Tier1
- To: Tier2

Conditions:

- Name
- I/O Density
- I/O Rate
- I/O Density
- Size
- Last Accessed: In last 24 hours
- Last Accessed: Over 1 day ago
Intelligent ILM Pilot Demonstrations

ISTM: Intelligent Storage Tiering Manager

New Policy

- **Name**: Tier 1 to 2
- **Unit**: Volume
- **Type**: Migration
- **From**: Tier 1
- **To**: Tier 2
- **Conditions**: Name (Add condition)
- **I/O Density**
  - Operator: >=
  - Value: 0.5
  - Unit: IO/sec/GB

Save | Cancel
Intelligent ILM Pilot Demonstrations

ISTM: Intelligent Storage Tiering Manager

Policy Details View:

- **Name:** Tier 1 to 2
- **Unit:** Volume
- **Type:** Migration
- **From:** Tier1
- **To:** Tier2
- **Conditions:** I/O Density >= 0.5 IO/sec/GB
Intelligent ILM Pilot Demonstrations

ISTM: Intelligent Storage Tiering Manager

<table>
<thead>
<tr>
<th>Name</th>
<th>Unit</th>
<th>Type</th>
<th>From</th>
<th>To</th>
<th>Datatype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1 to 2</td>
<td>Volume</td>
<td>Migration</td>
<td>Tier1</td>
<td>Tier2</td>
<td></td>
</tr>
<tr>
<td>Tier 2 to 1</td>
<td>Volume</td>
<td>Migration</td>
<td>Tier2</td>
<td>Tier1</td>
<td></td>
</tr>
</tbody>
</table>

Policy Detail View:

- **Name**: Tier 2 to 1
- **Unit**: Volume
- **Type**: Migration
- **From**: Tier2
- **To**: Tier1
- **Conditions**: I/O Density < 0.5 IO/sec/GB
Intelligent ILM Pilot Demonstrations

ISTM: Intelligent Storage Tiering Manager

**Main**

- **Policies:** Preview, Active
- **Mode:** Normal Run, Fast Run, Stop
- **Get Status**

**Status:** Preview Policies: Policy Assessment started successfully.

**Tiers**

- Policies
- Impact
- Deploy
Intelligent ILM Pilot Demonstrations

ISTM: Intelligent Storage Tiering Manager

<table>
<thead>
<tr>
<th>Tiers</th>
<th>Cost</th>
<th>Cost (P)</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier1</td>
<td>783.86</td>
<td>786.48</td>
<td>2.62</td>
</tr>
<tr>
<td>Tier2</td>
<td>212.73</td>
<td>211.51</td>
<td>1.22</td>
</tr>
<tr>
<td>Tier3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Unassigned</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Overall Cost Difference: 1.4
Intelligent ILM Pilot Demonstrations

ISTM: Intelligent Storage Tiering Manager

Policies
Policy Assessment Tool
Reports
Config
Upload
Sample Assessment

Main
Tiers
Policies

GB Moved

<table>
<thead>
<tr>
<th>Policy</th>
<th>Affected (GB)</th>
<th>Total (GB)</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Tier 1 to 2</td>
<td>0.0</td>
<td>598.37</td>
<td>0.0</td>
</tr>
<tr>
<td>Tier 2 to 1</td>
<td>2.0</td>
<td>348.73</td>
<td>0.37</td>
</tr>
</tbody>
</table>

Impact Deploy
## Intelligent ILM Pilot Demonstrations

### ISTM: Intelligent Storage Tiering Manager

<table>
<thead>
<tr>
<th>ID</th>
<th>Volume</th>
<th>Size (GB)</th>
<th>Policy</th>
<th>Source</th>
<th>Target</th>
<th>Resp MS/Op</th>
<th>Resp MS/Op (P)</th>
<th>Total amount migrated: 2 GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>600307680185602AF80000000001</td>
<td>vdisk32</td>
<td>1.0</td>
<td>Tier 2 to 1</td>
<td>POOL3</td>
<td>POOL7</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>600307680185602AF80000000001</td>
<td>vdisk33</td>
<td>1.0</td>
<td>Tier 2 to 1</td>
<td>POOL3</td>
<td>POOL8</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>

### Predicted Effect:

<table>
<thead>
<tr>
<th>Name</th>
<th>HDD Avg</th>
<th>HDD Avg (P)</th>
<th>-</th>
<th>HDD Max</th>
<th>HDD Max (P)</th>
<th>-</th>
<th>SMP</th>
<th>SMP (P)</th>
<th>-</th>
<th>HA</th>
<th>HA (P)</th>
<th>-</th>
<th>DA</th>
<th>DA (P)</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Deploy
Intelligent ILM Pilot Demonstrations

Real-World Example – Capacity Utilization

![Chart showing capacity utilization comparison before and after pilot demonstrations. The chart includes a bar graph and a table summarizing the cost and cost savings across different tiers. The table details the cost savings in each tier, showing a significant overall cost difference.]

<table>
<thead>
<tr>
<th>Tier</th>
<th>Current Cost</th>
<th>Cost Savings</th>
<th>Overall Cost Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>184572.19</td>
<td>156456.63</td>
<td>-28115.56</td>
</tr>
<tr>
<td>Tier 2</td>
<td>31587.33</td>
<td>46295.72</td>
<td>14708.39</td>
</tr>
<tr>
<td>Tier 3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Overall Cost Difference: -13407.17
Intelligent ILM Pilot Demonstrations

Real-World Example – Policy Effectiveness

<table>
<thead>
<tr>
<th>Policy</th>
<th>Affected (GB)</th>
<th>Total (GB)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy 1</td>
<td>896.0</td>
<td>960.0</td>
<td>93.33</td>
</tr>
<tr>
<td>Policy 2</td>
<td>1920.0</td>
<td>2208.0</td>
<td>86.96</td>
</tr>
<tr>
<td>Policy 3</td>
<td>7732.0</td>
<td>13067.0</td>
<td>59.17</td>
</tr>
<tr>
<td>Policy 4</td>
<td>8192.0</td>
<td>8192.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Policy 5</td>
<td>1200.0</td>
<td>1500.0</td>
<td>80.0</td>
</tr>
<tr>
<td>Policy 6</td>
<td>3296.0</td>
<td>3416.0</td>
<td>96.49</td>
</tr>
</tbody>
</table>
## Intelligent ILM Pilot Demonstrations

### Real-World Example – Impact

**Action List: 250**

<table>
<thead>
<tr>
<th>ID</th>
<th>Volume</th>
<th>Size (GB)</th>
<th>Policy</th>
<th>Source</th>
<th>Target</th>
<th>Resp MS/Op</th>
<th>Resp MS/Op (P)</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>600507680185802AF80000000</td>
<td>vdisk27</td>
<td>1.0</td>
<td>Tier 1 to 2</td>
<td>POOL8</td>
<td>POOL5DS8K</td>
<td>1.93</td>
<td>0.60</td>
<td>-1.33</td>
</tr>
<tr>
<td>600507680185802AF80000000</td>
<td>vdisk42</td>
<td>1.0</td>
<td>Tier 1 to 2</td>
<td>POOL8</td>
<td>POOL5DS8K</td>
<td>1.93</td>
<td>0.60</td>
<td>-1.33</td>
</tr>
<tr>
<td>600507680185802AF80000000</td>
<td>Demo2</td>
<td>5.0</td>
<td>Tier 1 to 2</td>
<td>DRPlanMDG</td>
<td>POOL5DS8K</td>
<td>1.67</td>
<td>0.60</td>
<td>-1.07</td>
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<tr>
<td>600507680185802AF80000000</td>
<td>vdisk40</td>
<td>1.0</td>
<td>Tier 1 to 2</td>
<td>POOL7</td>
<td>POOL5DS8K</td>
<td>1.64</td>
<td>0.60</td>
<td>-1.04</td>
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<tr>
<td>600507680185802AF80000000</td>
<td>vdisk41</td>
<td>1.0</td>
<td>Tier 1 to 2</td>
<td>POOL7</td>
<td>POOL5DS8K</td>
<td>1.64</td>
<td>0.60</td>
<td>-1.04</td>
</tr>
<tr>
<td>600507680185802AF80000000</td>
<td>vdisk44</td>
<td>1.0</td>
<td>Tier 1 to 2</td>
<td>POOL7</td>
<td>POOL5DS8K</td>
<td>1.64</td>
<td>0.60</td>
<td>-1.04</td>
</tr>
</tbody>
</table>

**Predicted Effect:**

<table>
<thead>
<tr>
<th>Name</th>
<th>HDD Avg</th>
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<th>SMP</th>
<th>SMP (P)</th>
<th>-</th>
<th>HA</th>
<th>HA (P)</th>
<th>-</th>
<th>DA</th>
<th>DA (P)</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1 Subsystem (1/4)</td>
<td>3.42</td>
<td>3.21</td>
<td>-0.21</td>
<td>20.24</td>
<td>18.01</td>
<td>-2.24</td>
<td>53.52</td>
<td>50.89</td>
<td>-2.63</td>
<td>4.1</td>
<td>3.96</td>
<td>-0.14</td>
<td>76.62</td>
<td>72.02</td>
<td>-4.6</td>
</tr>
<tr>
<td>Tier 2 Subsystem</td>
<td>0.38</td>
<td>2.49</td>
<td>2.1</td>
<td>0.67</td>
<td>3.02</td>
<td>2.35</td>
<td>2.22</td>
<td>5.7</td>
<td>3.47</td>
<td>0.8</td>
<td>2.08</td>
<td>1.28</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Tier 1 Subsystem (2/4)</td>
<td>10.88</td>
<td>10.87</td>
<td>-0.0</td>
<td>19.25</td>
<td>19.25</td>
<td>-0.0</td>
<td>7.93</td>
<td>7.93</td>
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<td>25.09</td>
<td>25.08</td>
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<td>-0.02</td>
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<td>20.31</td>
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<td>-1.02</td>
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<td>-0.3</td>
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<td>-0.95</td>
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Intelligent ILM Pilot Demonstrations

- ISPM (Spark)  the Intelligent Storage Provisioning Manager

[Screen captures follow that are excerpted from ISPM (Spark) demonstration]

  - Provisioning Recommendation
    - Input
    - Algorithm
    - Deployment
### ISPM: Intelligent Storage Provisioning Manager

#### Recommendations

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<th>Field</th>
<th>Value</th>
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<td>Prefix</td>
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<tr>
<td>VDiskz</td>
<td>5</td>
</tr>
<tr>
<td>Site</td>
<td>2</td>
</tr>
<tr>
<td>WWPNs</td>
<td>1000000000072051C</td>
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**Create Recommendations**

- Async

**Get Recommendations**

- Rec ID

#### Candidates

- FOC01DS8K, FOC01DS8K, FOC01DS8K, FOC01DS8K, FOC01DS8K@SVC-2145-swarm-IBM

#### IO Groups

-

#### Hosts

- 1111111111111111, 22222222222222222host

**Datatype**

- None

**Rec ID**

- Reserve, Deploy, Reject

### Table

<table>
<thead>
<tr>
<th>Name</th>
<th>Size</th>
<th>Units</th>
<th>NDC</th>
<th>IO Group</th>
<th>SVC</th>
<th>Prof Node</th>
<th>WWPN</th>
<th>Host</th>
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### ISPM Recommendation

#### Candidates

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<tr>
<td>MDG</td>
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<td>POOL6D68K</td>
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<td>Valid</td>
</tr>
<tr>
<td>MDG</td>
<td>POOL8D68K</td>
<td>Valid</td>
</tr>
</tbody>
</table>

**Explanation**

```
********** WHITBOX PLANNING **********

MDG: POOL5D68K -- CANDIDATE if chosen, estimated max utilization of this MDG would have been 0.02

MDG: POOL6D68K -- INVALID candidate mdiskgroups since it does not have enough allocatable space to provision vdisks (considering thin-provisioning and overallocation bound, if applicable)

MDG: POOL7D68K -- CANDIDATE if chosen, estimated max utilization of this MDG would have been 0.013334043209675544

MDG: POOL8D68K -- CANDIDATE if chosen, estimated max utilization of this MDG would have been 0.013334043209675544

IOMGRUOP: io_grp0 -- CANDIDATE
```
Thank you for attending!
References


  - [EDGE-LR1] Laura Richardson, “Storage and Data Governance via an Intelligent Storage Service Catalog (ISSC)”
  - [EDGE-MS1] Mike Sylvia, “IBM’s Storage Transformation”
  - [EDGE-MG1] Mike Griese, “IBM TPC 5.1 New Features and Functions”

- [SBLOG1] Tony Pearson’s “Inside System Storage” blog http://ibm.co/brAeZ0

- [SNIA-ILM1] Edgar St Pierre, SNIA Tutorial “ILM Tiered Services & the Need for Classification”

  - [STORES-SPARK1] Virtualization Management via SPARK (renamed ISPM)
  - [STORES-SAGE1] ILM data valuation and policy based migration (renamed ISTM)

- [SVC1] SAN Volume Controller product web page http://snurl.com/ibm-svc1

- [TPC1] Tivoli Storage Productivity Center product web page http://snurl.com/ibm-tpc1

- [VSC1] SmartCloud Virtual Storage Center product web page http://snurl.com/ibm-vsc1

- Mind Map including all references: http://snurl.com/gts-int-ilm-evol-map (requires Freeplane)
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