z/OS 1.9: Large Page Support

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Agenda

- Large Page Performance Considerations
- Overview of z/OS Large Page Implementation
  - IEASYSxx Changes
  - IARV64 Changes
  - RMF Changes

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Large Page Performance Considerations

- Large Page support is a special purpose performance improvement feature
  - Not recommended for general use
  - Large page usage provides performance value to a select set of applications, primarily long running, memory access intensive applications

- Some applications can be severely degraded by the use of large pages
  - Short lived processes with small working sets are usually not good candidates for large pages

- The system will not "rush" to build a 1MB page
  - When the large pages are requested it may take awhile for the request to be satisfied
Enable Large Pages via IEASYSxx

- New keyword in IEASYSxx called LFArea specifies the amount of real storage to be used for Large Pages
  - $LFArea=(xx\%|xxxxxxxM|xxxxxxxG)$
    - $xx\%$ - Percentage of online storage at IPL to be used for Large Pages
    - $xxxxxxxM$ or $xxxxxxG$ – Amount of online storage at IPL to be used for Large Pages
z/OS Large Page Support Overview

- The z/OS Large Page size is 1 Megabyte
- *Both 4K and 1MB page sizes are supported*
- If the system is constrained for 4K pages, free 1MB pages will be used to back 4K page requests
- Pages can later be coalesced into 1MB pages
- 1MB Large Pages will NOT be reconfigurable
z/OS Large Page Support Overview

- Large Pages are backed by 256 contiguous 4K real storage frames
- Large Page support is available only for 64-Bit Virtual Private storage
- The request to use 1MB pages is expressed as an attribute of the memory object
  - Memory Object Pages are backed at allocation time
    - The entire “usable” virtual address range of a memory object backed by large pages will be backed when the virtual memory object is obtained
      - Guard Areas will not be backed
    - Memory Object is implicitly fixed at allocation time
**z/OS Large Page Paging Support**

- Large Pages will be NOT be pageable
  - *Large Pages will be treated as fixed pages and will not be paged out to AUX*
  - *Primary reason is because certain control structures used for paging to Aux are not created for large pages*
  - *Other reasons include:*
    - The great delay in paging in a 1MB page
    - The expense of constructing 1MB of contiguous real storage from 256 4K frames when required
z/OS Large Page Support Overview

- The following IARV64 requests will operate on Large Pages

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GETSTOR</td>
<td>Creates a 64-Bit private memory object that can be backed by Large Pages</td>
</tr>
<tr>
<td>DETACH</td>
<td>Frees a memory object that can be backed by Large Pages</td>
</tr>
<tr>
<td>CHANGEGUARD</td>
<td>Changes the amount of guard area within the specified memory object</td>
</tr>
<tr>
<td>LIST</td>
<td>Provides information about memory objects</td>
</tr>
</tbody>
</table>

- IARV64 has a new keyword called PAGEFRAMESIZE=
  - 4K (default)
  - 1M (Requests 1MB pages)
  - MAX (Requests the largest page size supported)

- All APIs enhanced for Large Page support will require the requestor to be authorized
Large Page Support Overview…

- The following example shows how a memory object that is to be backed by Large Pages is created:

```
IARV64 REQUEST=GETSTOR +
   SEGMENTS=THREE_SEG, +
   ORIGIN=VIRT64_ADDR, +
   PAGEFRAMMESIZE=1MEG, +
   GUARDLOC=LOW, +
   GUARDSIZE=ONE_SEG, +
   SVCDUMPRGN=NO, +
   COND=YES
```
## IARV64 GETSTOR Request Operation

<table>
<thead>
<tr>
<th>2097 Processor</th>
<th>z/OS Release</th>
<th>Issue IARV64 GETSTOR with Pageframesize=</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>z/OS 1.9 with OA20902 applied</td>
<td>Request will be accepted</td>
</tr>
<tr>
<td>Yes</td>
<td>Pre z/OS 1.9 or z/OS 1.9 without OA20902</td>
<td>Request will be rejected</td>
</tr>
<tr>
<td>No</td>
<td>z/OS 1.9 with OA20902 applied</td>
<td>Request will be rejected when pageframesize=1M Request will be backed with 4K pages when pageframesize=MAX</td>
</tr>
<tr>
<td>No</td>
<td>Pre z/OS 1.9 or z/OS 1.9 without OA20902</td>
<td>Request will be rejected</td>
</tr>
</tbody>
</table>
RMF Enhancements for z10 Processor – OA12774

- **Postprocessor Paging Activity Report**
  - *Frame and Slot count section extended with a new section on memory object usage*
    - Minimum, maximum and average numbers of 1 MB frames backed in real storage
    - Number of large memory objects allocated in the system

- **RMF Monitor III Central Storage Summary**
  - *STORR (Storage Resource Delays) and STORS (Storage Delay Summary) reports displays the total number of large memory objects allocated in the system and the number of 1 MB frames backed in real storage*
  - *STORF (Storage Frames) report displays the number of 1 MB frames per address space backed in real storage*