Spectre and Meltdown Performance Documentation

The following patches can be applied according to RHE's CVE:

- kernel-3.10.0-514.36.5.el7.x86_64.rpm
- linux-firmware-20160830-51.git7534e19.el7_3.noarch.rpm
- microcode_ctl-2.1-16.5.el7_3.x86_64.rpm

- GPFS IO Performance
  - Comments
    - Impact of ‘Page Table Isolation (pti)’ fix only
  - Application Performance
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    - Gear
    - CPMD
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    - Quantum Espresso

In order to quantify the impact of the Spectre / Meltdown fixes a number of tests have been run. Unless otherwise stated all results are from the Fidis cluster.

If all the recommended fixes are applied then we see a large impact on IO. As computational kernels do not require frequent calls to the operating system the impact is far less significant.

GPFS IO Performance

IOR API=POSIX
IOR GPFS before and after Spectre and Meltdown fixes
16-Jan-2018, GPFS-4.2.2-2, Intel E5-2690-v4 2.60GHz, Linux 3.10.0-514.36.5
IOR: api=POSIX, filePerProc=1, xfsize=16k, aggregate filesize=256GB

IOR before and after Spectre and Meltdown fixes
16-Jan-2018 IOR: api=POSIX, filePerProc=1, xfsize=16k, aggregate filesize=256GB
**Comments**

Impact is a loss of about 50% aggregate bandwidth when running IOR with one MPI task-per-node.

Impact is much less visible when running IOR with 16 MPI tasks-per-node.

**Impact of 'Page Table Isolation (pti)' fix only**
Situation of Fidis compute nodes after maintenance of January 24th, 2018:

**Application Performance**

**MiniFE**

Total running time in seconds on Fidis (lower is better)

<table>
<thead>
<tr>
<th>nodes</th>
<th>size</th>
<th>before</th>
<th>after</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1000x500x600</td>
<td>34.9368</td>
<td>33.9214</td>
</tr>
<tr>
<td>2</td>
<td>1000x500x600</td>
<td>67.2132</td>
<td>67.2067</td>
</tr>
</tbody>
</table>

**Gear**

*Large* test case. Steps per unit of time (higher is better)

<table>
<thead>
<tr>
<th>nodes</th>
<th>before</th>
<th>after</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.225932</td>
<td>0.224453</td>
</tr>
<tr>
<td>2</td>
<td>0.397746</td>
<td>0.395822</td>
</tr>
<tr>
<td>4</td>
<td>0.626741</td>
<td>0.622084</td>
</tr>
</tbody>
</table>

**CPMD**

Average time per iteration in seconds (lower is better)

<table>
<thead>
<tr>
<th>nodes</th>
<th>before</th>
<th>after</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SPEC benchmark (CPU FP SPEED)

SPEC points (higher is better)

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>67.9</td>
<td>66.6</td>
</tr>
</tbody>
</table>

Quantum Espresso

```plaintext
espresso: version: 6.2.0
arch: platform: linux
platform_os: rhel7
target: x86_E5v4_Mellanox
compiler:
  name: intel
  version: 17.0.2
namespace: builtin
parameters:
  elpa: true
  hdf5: false
  mpi: true
  openmp: false
  scalapack: true
```

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>1m22.35s CPU 1m27.18s WALL</td>
<td>1m26.21s CPU 1m37.75s WALL</td>
</tr>
</tbody>
</table>