STK (Sierra Toolkit) Update

Trilinos User Group meetings, Oct 2012

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Review & Approval: SAND2012-9253C
Sierra ToolKit (STK) modules overview

Parallel-consistent Mesh database
- Heterogeneous element types
- Unstructured

Algorithm-Support (AlgSup)
- Multi-threaded execution of bucket-loop algorithms

Search
- Proximity, mesh independent

Linsys, IO, Rebalance
- Bridges from mesh-data to external capabilities
- Built optionally

Util
- Everything depends on util directly or indirectly

Transfer
- Not yet implemented

Dependency diagram:
- Arrows point towards a module that is used (depended on) by another module.
STK Mesh

- Parallel distributed, parallel consistent
- Heterogeneous element types and field types
- Unstructured mesh
Simple Mesh Performance test: element-node gather

- **Test:**
  For each element, gather data (coords) from connected nodes, perform computation (in this case, trivial centroid calculation)

- **Goal:**
  Stress mesh traversal (relations), and field-data access

```
1 million Hex-8 elements, 100 iterations (sweeps)
```

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<table>
<thead>
<tr>
<th>Framework</th>
<th>Time (sec)</th>
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<tbody>
<tr>
<td>Fmwk</td>
<td>5.4x</td>
</tr>
<tr>
<td>stk-mesh</td>
<td>4.7x</td>
</tr>
<tr>
<td>stk-mesh (fast_gather)</td>
<td>3.0x</td>
</tr>
<tr>
<td>csr-mesh</td>
<td>2.7x</td>
</tr>
<tr>
<td>stk-samba</td>
<td>1x</td>
</tr>
<tr>
<td>Array-mesh</td>
<td>1x</td>
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```
Next task: improve stk-mesh using lessons learned from research meshes

Value semantics:
• Entity object is replaced by ‘index’ into mesh

Memory reorganization:
• Use topology information in buckets to enable storing downward connectivities (aka relations) in contiguous memory

Usability/clarity:
• Combine classes that were separated due to implementation reasons

Issue:
• Want to protect non-Sierra users of STK from upcoming churn
• Allow them to adopt changes on their own schedule
The Sierra source repository contains a copy of Trilinos, which contains STK.

Updates go back and forth.
To protect non-Sierra STK users from churn, temporarily duplicate STK in Sierra…

We’ll make our changes in ‘New STK’, leave STK alone.
Later, move new STK to Trilinos, allow non-Sierra users to transition at their leisure

Organization and naming of old and new STK is open question: Subpackages? Packages?