Evaluating SCA 4.1 features in action
– Lessons and Metrics –

WInnComm 2015
Workshop 5C: Evaluation, Analysis and Prototype of SCA 4.1 Results
Outline

- Who is NordiaSoft?
- What is SCAv4?
- SCAv4 Key New Features
- Lessons learned with SCAv2.2.2
- Some Metrics
- SCAv4.1 Change Proposals for New Features
Who is NordiaSoft?

- NordiaSoft offers Products and Services for the development of SCA platforms
  - SCARI Software Suite: most popular IDE for SCA
  - SCARI GT: Core Framework deployed in thousands of fielded SCA Radios
  - Services: Consulting and training. We can make your platform SCA compliant
- Our team: over 80 years of combined SCA experience
- Office: Gatineau, Québec, Canada
- Products: licensed to over 50 organizations in 16 countries
  - Americas, Europe, Middle-east, and Asia
  - Thousands of radios deployed to the battlefield
What is SCAv4?

- SCAv4.1 is a draft release of SCAv4 [code name SCA Next] that is expected to implementable

- SCAv4.0 is the first draft release of the specification since SCAv2.2.2 that includes a number of new features
  - Changes come from years of experience implementing SCAv2.2.2
  - New features to allow developers to implement light-weight components
  - New features to enable shorter booting sequences – improved boot time
  - New features to minimize footprint requirements

- Ultimately, SCAv4 broadens applicability of SCA beyond U.S. military Software Defined Radios
SCAv4 Key New Features

- **SCAv4 is backwards compatible to SCAv2.2.2**
  - Launch SCAv2.2.2 applications on a SCAv4.1 platform
  - Launch SCAv2.2.2 application components as part of SCAv4.1 applications**

- **SCAv4 supports varying levels of granularity for components**
  - Components can implement only the standard interfaces that are required
  - Ex: a component with no properties doesn’t have to implement the PropertySet interface
  - This can help reduce footprint requirements
  - This can also help address some IA requirements
SCAv4 Key New Features

- **SCAv4 now uses a new registration interface: push vs pull**
  - SCAv2.2.2 was mostly implemented by letting key components pull the information they needed
  - SCAv4 is focused on allowing components to provide more information at registration to avoid pulling
  - This feature can save several interactions and avoid reparsing of some XML information
  - The anticipated result is a faster boot sequence

- **SCAv4 also add support for the push approach to establish connections between components**
  - Components can register all their ports during registration
  - Connections can be established in bulk
  - The anticipated result is a shorter connection sequence
SCAv4 Key New Features

- **SCAv4 now supports the concept of factories for Device/service components**
  - SCAv2.2.2 only supported factories for application components
  - SCAv4 generalizes the Factory concepts to both node and application components
  - The feature can save tremendous amount of memory
  - The feature can also drastically accelerate communications between components with good real time ORBs
Lessons learned with SCAv2.2.2

- **SCARI GT is NordiaSoft’s SCA Core Framework**
  - It has been deployed by different radio manufacturers, on radios of varying sizes, and on thousands of radios deployed worldwide.

- **Boot Time is Paramount**
  - SCARI GT has been optimized with several features to accelerate the SCA boot sequence. Over the years, several features have been implemented.
  - What was recognized as a common problem for many radios is the poor performances of the file systems.
  - Anything that prevents the unnecessary parsing of XML files leads to great performance improvements.
  - Push registration is one trick SCARI GT uses to avoid reading files.
Lessons learned with SCAv2.2.2

- **Flexibility for Address Space configurations is essential**
  - SCARI GT and SCA Architect offer several features to allow developer to make last minute changes for address space configurations
  - Running many application components into a single address space can provide significant footprint savings and speed improvement
  - SCA Architect can automatically generate a ResourceFactory from any application components
  - SCA Architect can automatically change a component from being linked into a stand-alone Executable into a Shared Library
  - SCARI GT’s ExecutableDevice provides an ExecutableDevice that can run components as processes or as threads
Lessons learned with SCAv2.2.2

- Connections have not been a major performance issue
  - The speed at which an SCA Core Framework can establish connections between components has not been a major performance issue amongst NordiaSoft customers
  - Experiments with real radios have led to data collection that did not expose performance issues
  - SCARI GT uses a caching approach to establish connections

- Connections could be more of an issue on an RTOS with a partition scheduler
  - Establishing a one-way connections between components hosted in different partitions could have to wait for two full rounds of scheduling
  - But there is a simple design pattern to avoid this issue with SCAv2.2.2
Some Metrics

- **Boot Time is Paramount**
  - SCARI GT offers the possibility of performing push registration in one single call which can save up to 19 CORBA calls per registering Device
  - Some of the calls have to do with reading XML from a remote and slow embedded file system

<table>
<thead>
<tr>
<th>Test Scenarios</th>
<th>Standard Registration</th>
<th>One call Registration</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linux Desktop, 1 Device</td>
<td>0.56 sec</td>
<td>0.19 sec</td>
<td>~ 66%</td>
</tr>
<tr>
<td>Linux Desktop, 4 Devices</td>
<td>1.53 sec</td>
<td>0.24 sec</td>
<td>~ 84%</td>
</tr>
<tr>
<td>LynxOS PPC405GPr, 1 Device</td>
<td>0.86 sec</td>
<td>0.13 sec</td>
<td>~ 85%</td>
</tr>
<tr>
<td>LynxOS PPC405GPr, 4 Devices</td>
<td>2.33 sec</td>
<td>0.22 sec</td>
<td>~ 91%</td>
</tr>
</tbody>
</table>

- **SCAv4.1 Push registration will allow similar performance gains**
Some Metrics

- **Flexibility for Address Space configurations is essential**
  - SCARI GT and SCA Architect offer several features to allow developer to make last minute changes for address space configurations

<table>
<thead>
<tr>
<th>Average Round Trip Time in usec for PPC405GPr (400MHz) running INTEGRITY RTOS and ORBexpress</th>
<th>Double Sequence</th>
<th>Octet Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>using TCP/IP</td>
<td>1024</td>
<td>2048</td>
</tr>
<tr>
<td></td>
<td>3334</td>
<td>7272</td>
</tr>
<tr>
<td>using INTCO corrected</td>
<td></td>
<td>1428</td>
</tr>
<tr>
<td></td>
<td>1767</td>
<td>7272</td>
</tr>
<tr>
<td>using direct method invocation thanks to a ResourceFactory that yielded 40% smaller footprint</td>
<td></td>
<td>1042</td>
</tr>
<tr>
<td></td>
<td>2215</td>
<td>4728</td>
</tr>
<tr>
<td></td>
<td>1273</td>
<td>1767</td>
</tr>
<tr>
<td></td>
<td>244</td>
<td>492</td>
</tr>
<tr>
<td></td>
<td>231</td>
<td>155</td>
</tr>
</tbody>
</table>

- **SCAv4.1 ComponentFactory will allow similar performance gains for both application assemblies and node assemblies**
Some Metrics

- **Flexibility for Address Space configurations is essential**
  - SCARI GT and SCA Architect offer several features to allow developer to make last minute changes for address space configurations

<table>
<thead>
<tr>
<th>Average Round Trip Time in usec for Intel i7-4770 (3.4GHz) running Linux and ORBexpress</th>
<th>Average Packet Round Trip Time for 1024 doubles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using TCP/IP running as separate executables</td>
<td>815</td>
</tr>
<tr>
<td>using direct method invocation thanks to a ResourceFactory</td>
<td>31</td>
</tr>
</tbody>
</table>

- **SCAv4.1 ComponentFactory will allow similar performance gains for both application assemblies and node assemblies**
SCAv4.1 Change Proposals for New Features

- **Core Affinity**
  - Would allow applications to benefit from Multi Core processors
  - Could define a Core Affinity for an SCA Component to be launched
  - Offers performance optimization

- **Process Assignment**
  - Would allow developers to define within which process a component must be launched
  - Would allow dynamic creation of processes to run host specific components
  - Offers performance optimization

- **Ultimately, SCAv4 broadens applicability of SCA beyond U.S. military Software Defined Radios**
Evaluating SCA 4.1 features in action

– The End –