Standards for SDR; a Canadian Perspective

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- Overview of the Canadian market
- CRC’s Perspective on SDR
- The SCA and it’s ecosystem
- The SCA; What’s next?
- Conclusion
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Canadian Market

• **Canada is 2\textsuperscript{nd} largest country**
  – 219\textsuperscript{th} for population density
  – Population: 33 million

• **Need for communications**
  – Canada was unified by the railway
  – Solidified by satellites
  – Telecommunications is crucial

• **Canadian internal market remains small**
  – USA population: 302 million
  – USA: 1,426,700 military personnel, 1,259,000 reserve
  – Canada: 62,000 military personnel, 22,000 reserve
Canadian Industry

- Canadian industry must create products that are applicable to commercial and military markets
  - Can’t rely on multi-billion projects like the US JTRS program

- Must use/create international standards and Commercial Off The Shelf (COTS) products
  - Can’t afford expensive one-of-a-kind systems
  - Provides access to international markets
  - Allows cost reduction through increased volume
CRC’s Perspective on SDR

• There are many standards for embedded systems hardware
  – PCI, PCI-X, cPCI, RapidIO, VME, PMC, XMC, PC/104, JTAG, USB, etc.
  – Provides a market to smaller players

• The complexity of embedded systems is on a constant rise
  – More software is used to address the complexity
  – In many cases, the cost of software is greater than the cost of hardware
  – The goal with SDR is to increase the amount of functionality implemented in software
  – Ironically, there is almost no standards in the embedded software industry
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In 1999, Defence R&D Canada (DRDC) became interested in Software Defined Radios.

The CRC decided to evaluate the SCA standard:
- The US was about to launch the multi-billion Joint Tactical Radio Systems (JTRS) program.
- The architecture seemed generic enough to meet the requirements of our SDR prototype.

Developed a FM LoS SDR prototype using SCAv0.3:
- Used a dual TI DSP board from Spectrum Signal Processing.
- Resulted in several change proposals submitted to the Modular Software-programmable Radio Consortium (MSRC).
- The MSRC integrated the proposals into SCAv1.0.
CRC’s Perspective on SDR

- SCAv0.3 LoS FM SDR prototype (2000)
CRC’s Perspective on SDR

• Conclusions of the prototyping project
  – The SCA can be implemented
  – The SCA is in fact a Component-based Design architecture for embedded systems
    • Similar to Enterprise Java Beans and .Net
  – The SCA is not specific to SDR or to military applications
  – The SCA specification can be influenced
    • CRC has successfully influenced every release of the specification: from version 0.3 to version 2.2.2
    • Submitted over 25 official change proposals
  – The SCA is unique and at the forefront of embedded software development
CRC’s Perspective on SDR

• Since the SCA specification is publicly available, the Canadian industry can play a role in the SDR market

• The SCA has been demonstrated to work on very large and very small platforms:
  – Universal Software Radio Peripheral (USRP): Gnu Radio RF front end
  – Gumstix: Tiny single board computer
  – Thales JTRS Enhance MBITR (JEM): Handheld military radio
  – Harris Falcon III: Handheld military radio
  – Ultra Electronics TCS HCLOS™: Backbone networking radio
CRC’s Perspective on SDR

- Universal Software Radio Peripheral (USRP): Gnu Radio RF front end
  - Commercial RF Device with 4 channels
  - CRC developed an SCA AM/FM radio with USRP
CRC’s Perspective on SDR

- **Gumstix**:
  - CRC used a Gumstix™ Audio Pack to implement an SCA FM radio (XScale processor)
  - Audio Pack: 1.5 cm high, 3cm wide, 10cm long.
CRC’s Perspective on SDR

- **Thales JTRS Enhance MBITR (JEM):**
  - AN/PRC-148 SCA handheld military radio
  - Retrofitted with a DSP (TBC)
CRC’s Perspective on SDR

- **Harris Falcon III:**
  - AN/PRC-152 SCA handheld military radio
  - SCA certified without waivers
CRC’s Perspective on SDR

- Ultra Electronics TCS HCLOS™: Networking radio
  - AN/GRC-245 HCLOS™ military radio
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The SCA

• The SCA helps standardize some aspects of the software:
  – How the software can be configured, started, stopped
  – How software gets installed and launched

• The SCA makes application software more portable
  – The use of Portable Operating System Interfaces (POSIX)
  – The use of CORBA as a middleware
The SCA Ecosystem

- The SCA has fostered an ecosystem of COTS products and services for radio manufacturers
  - SCA Core Frameworks
    - Application deployment and configuration
    - Basic Device functionality
  - Code generation tools
    - Translate models into source code: Model Driven Development
  - Runtime monitoring tools
    - Install, launch, and debug applications
    - View log messages and events
  - Waveform application software
    - Implementation of standards: TETRA, APCO-P25, 3G, etc.
The SCA Ecosystem

• Canadian providers of COTS SCA solutions for radio manufacturers:
  – The Communications Research Centre Canada:
    • COTS SCA Software Suite
  – Spectrum Signal Processing by Vecima
    • First COTS SCA platform
  – ISR Technologies:
    • First COTS platform with FPGA partial reconfiguration
  – Lyrtech Signal Processing:
    • First COTS platform with CORBA on FPGA and DSP
  – Zeligsoft:
    • Provides COTS modeling tools

• Canadian Radio Manufacturer - Ultra Electronics TCS:
  – Deployed the first military SCA radio that relies on a COTS SCA Core Framework (US Army, WIN-T)
The SCA Ecosystem

- Other providers of COTS SCA solutions for radio manufacturers:
  - United States:
    - Pentek – COTS SCA boards
    - PrismTech – COTS SCA Software Suite
    - Harris – COTS SCA Core Framework
  - Australia:
    - Etherstack – Waveform applications (ex: TETRA, APCO-P25)
The SCA Ecosystem

• The existence of an ecosystem of COTS SCA products and services has been instrumental
  – Organizations feel more confident to make the jump towards the SCA since it is a standard
  – The cost of entering the SCA market is greatly reduced
  – Previous achievements provide risk mitigation

• Outside the US, CRC is involved with more than 35 organizations using the SCA
  – Canada, UK, Germany, Italy, Israel, India, Singapore, Korea, China
The SCA Ecosystem

• COTS SCA products and services are speeding up the development process
  – Clarity/precision: Development starts at a higher level of abstraction
  – Reuse: High-level abstractions are translated into platform specific artifacts
  – Early visibility: Can quickly create prototypes
  – Greater flexibility: Developers can redesign almost at will
  – Fewer defects: Because of modeling wizards and model translation which greatly reduce manual coding
  – Reduced development cost: Shorter development cycles, time is money!
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The SCA community has not been successful at standardizing domain-specific APIs.
The SCA: What’s Next?

- The SCA needs standard domain-specific APIs
The SCA: What’s Next?

• Domain-specific APIs would provide a greater level of portability
  – Porting an application to a similar platform which uses different Radio hardware would not require API changes

• The SCA working group of the SDR Forum is looking for organizations to participate in an effort to assemble a set of SDR-specific APIs
  – Will look at several APIs:
    • JTRS newly released APIs
    • Will also look at the OMG Software-Based Communications models for communications equipment
      • Will look the SDRF Smart Antenna APIs
      • Will look at Transceiver APIs from Thales
  – Welcomes more contributions
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• Standards are essential to foster a healthy ecosystem around a technology
  – Lower cost of entry
  – Risk mitigation

• The SCA is only a start; it is an architecture supplemented with guideline for software development best practices
  – The SCA is not a military technology
  – The SCA is a Component-based Design architecture for embedded systems

• The SCA works for small and large military and commercial applications
Conclusion

• The next big step for the SCA community is the development of standard APIs for radio hardware
  – The SCA Working group of the SDR forum will welcome any contribution
Questions ?

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