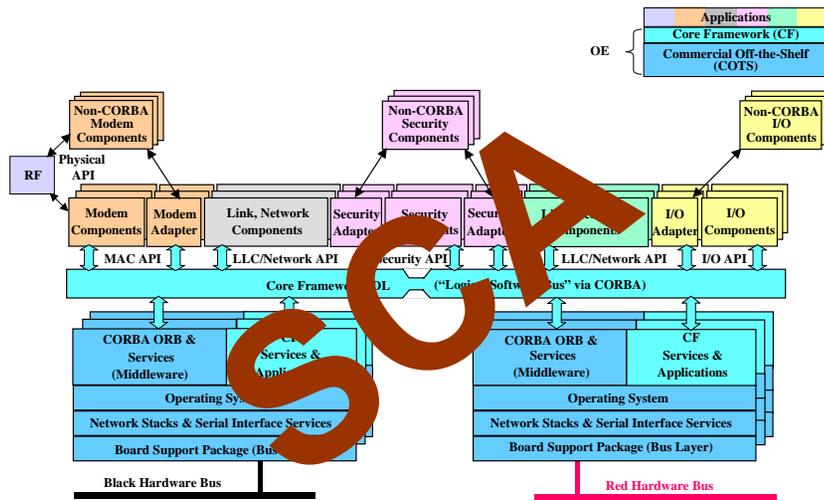# The JTRS SCA Specification...The Past, The Present, and The Future

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Objectives

❖ Provide an overview of reasons for creation of the SCA.

❖ Describe what the SCA is and what it enables for the military and the commercial communications industries.

❖ Discuss the past, present and future standardization efforts for this specification.

❖ Discuss the importance of involvement of all stake holders in related military and commercial standardization efforts such as those ongoing in the JTRS SCA Technical Architecture Group (TAG), the Object Management Group (OMG), and the Software Defined Radio (SDR) Forum.

JTRS Program Goals

Reasons for Formation of the JTRS Program

❖ Lack of interoperability, and

❖ Inability to keep up with the rapid speed of technology advancements...

❖ In the U.S. and ultimately the Allied and Coalition forces tactical communications systems

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The Goal of the JTRS Program

Portability, interoperability, quick and cost-effective development, upgrade, and maintenance of tactical communications systems.

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JTRS Target – A Family of Software Defined Radios

DOD Complaints to Radio Manufacturers:

"We can't support all your discrete radios"

"We can't fight the way we want to with your discrete radios"

"We can't introduce new technology at the pace of commercial industry"

JTRS Program

A DOD Joint Program for an information warfare communication system built on a family of HF-to-L-band radios with a common open architecture with these...

Requirements

- Software controlled and reprogrammable
- Modular and scaleable
- Extensive use of COTS technology
- Simplified applications engineering
- Rapid deployment of system improvements

SOFTWARE DEFINED RADIO

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What is a Software Defined Radio?

A Software Defined Radio is a wireless communication system (low-capability mobile phones to high-capability multi-channel radios), in which the particular communication and transmission characteristics are realized through specialized software running on flexible signal processing hardware. This is very different from the traditional approach of using specialized hardware and has the benefit of instant reuse or sharing of a single system platform for multiple communication purposes. Within the physical limits of the underlying hardware, virtually any communication task can be realized instantaneously through a software load, including the ability of extensive field-upgrades and maintenance.

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http://www.sdrforum.org

The Goal of the JTRS Program (Refined)

Portability, interoperability, quick and cost-effective development, upgrade, and maintenance of waveforms—software applications performing majority of communications functions in a radio...

among multiple and varying communications platforms.

The Software Communications Architecture

The SCA – Realizing the Goals of the JTRS Program

Standardization is key to the goals of the JTRS program.

This standardization is achieved via the SCA specification.

What is the SCA Specification?

The SCA specification is a standard for

- component portability,
- interchangeability, and
- interoperability,
- software reuse, and
- architecture scalability

for communications platforms.

What Does the SCA Do?

❖ Minimizes portability costs,

❖ Maximizes portability of one waveform among multiple platforms (different OSs, different hardware, different host environments (i.e. OEs)),

❖ Encourages plug and play component use and reuse (i.e. building a waveform using components manufactured by different vendors),

❖ Supports scalability of architectures (using the same architecture from handheld to base station).

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How Does the SCA Achieve It's Goals?

Standardizes the following:

- ❖ The infrastructure the waveforms run on (the infrastructure that hosts the waveforms) *(The Core Framework Framework Control and Framework Services Interfaces),*

- ❖ Segmentation and separation of functionality within a waveform and its components (so that a waveform can be broken down into its constituent pieces (i.e. componentized)) to use the plug and play architecture of using various components to build a waveform, and also, so that the infrastructure that hosts the waveforms has a standardized way of bringing up and communicating with the waveform *(The Core Framework Base Application and Base Device Interfaces),*

- ❖ The way the waveform expresses its deployment requirements *(The Domain Profile), and*

- ❖ A base definition of common APIs and the way to define new application-specific common APIs to promote further application portability.

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SCA Evolution

Inception of the SCA

In the late 1990's (beginning of the JTRS program), the JTRS JPO funds four of the top defense radio manufacturers to define a standard software architecture--the ***Software Communications Architecture (SCA)***-- that can support the JTRS Requirements.

– The Modular Software-programmable Radio Consortium (MSRC)

  ▪ Raytheon, BAE SYSTEMS, Rockwell-Collins, ITT

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Phased Development to Prove the Architecture Works

JTRS Step 1 – Architecture Development

- MSRC members develop initial architecture

JTRS Step 2a – Architecture Feasibility

- MSRC members deliver prototype radios -- SCA Core Framework and waveform implementations
- Specification maturation
- Pursue commercial acceptance (OMG/SDR Forum)

JTRS Step 2b – Independent Architecture Validation

- Non-MSRC members deliver prototype radios
  - Harris/General Dynamics deliver prototype radios
  - Boeing – Delivers SCA Core Framework
  - Thales/Vanu provides handheld radios
  - Rockwell-Collins provides prototype waveform software

JTRS Step 2c – Ruggedized Fieldable Radio

- BAE SYSTEMS chosen to deliver SCA compliant radios for field evaluation

Importance of Standardization in the Military and Commercial Sectors

SCA Compliance Mandatory on DoD NCO and NCW Programs

With multiple proof of concept prototypes, fielded and under development military production systems such as those from the JTRS step phases and JTRS Cluster 1, today, the SCA is the core standard for all DoD SBC programs involved with Network Centric Operations (NCO) and Network Centric Operations (NCW) such as

- JTRS Clusters,
- Family of Advanced Beyond-line-of-sight Terminals (FAB-T),
- Airborne and Maritime/Fixed Station, (Mergers of Clusters 3 & 4) (AMF), and
- Future Combat Systems (FCS).

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The SCA Inspires Emerging Commercial SW Radio and Deployment and Configuration Standards

The core rule set is a deployment and configuration engine that can form the component interoperability and portability basis in *any* SBC system, including commercial software radios.

The SCA specification forms the corner-stone basis that inspires many of today's emerging commercial and international standards such as the OMG *Platform-Independent Model and Platform-Specific Model for Software Radio Components* and the *Deployment and Configuration of Component-based Distributed Applications* specifications.

A Standardized Architecture is Required

To support the requirement of interoperability of applications (e.g. waveforms) and portability of one application among multiple platforms from different vendors (e.g. different domain radio hardware, different host environments (i.e. SCA OEs)), OE and waveform vendors must follow a *standardized* architecture for development of their waveforms and the development of the infrastructure that hosts these waveforms.

An international Standardized Architecture is Required

JTRS is envisioned to interoperate with Allied and Coalition forces.

Combined military operations can be greatly enhanced when all coalition partners can join a designated coalition communications network on demand.

Therefore, the JTRS JPO has been seeking to identify foreign SDR requirements and negotiate international agreements to enhance interoperability.

This broadens the scope of the SCA to go beyond U.S. military contracts and into commercial applications.

Standardization of the SCA is crucial not only in the military sector but also in the commercial/international sector.

Military, Commercial, and International Standardization Efforts

On Going Standardization Efforts

Military

- JTRS SCA Technical Architecture Group (TAG)

Commercial

- Software Defined Radio Forum (SDRF)
- Object Management Group (OMG)

International

- International discussions, agreements, and projects to enhance interoperability

The JTRS SCA TAG

❖ Originally funded by the JTRS JPO since the late 1990s.

❖ An SCA discussion forum, invites the JTRS community members to propose and develop change proposals to the SCA and its related appendices and supplements.

❖ Includes SCA software architects on various JTRS contracts from different radio, OE, and waveform vendors from the JTRS Step and various JTRS Cluster phases.

❖ Oversees submitted change proposals and leads various efforts to research, accept or reject each change proposal, and answer related questions from the outside community.

❖ Continued existence of this group is essential to keeping the SCA as a living and maturing document, governing U.S. military JTRS contracts.

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The JTRS SCA TAG *(cont.)*

❖ Ongoing work of SCA architects as members of the SCA Configuration Control Board (CCB), the SCA TAG, and the JTRS-related production programs have resulted in all revisions of the SCA since the late 1990s.

❖ Most recent revision to the main SCA specification was the mid 2004 SCA version 2.2.1 in which the major change was the replacement of the SCA 2.0 Log interface definition with the OMG Light Weight Log Service.

❖ Most recent SCA edition is the late 2004 SCA version 3.0, in which the *Specialized Hardware Supplement (SHS)* was added to the list of existing SCA supplements.

❖ https://jtel-sca.spawar.navy.mil/

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The SDR Forum

❖ An international, nonprofit organization dedicated to promoting the development, deployment, and use of SDR technologies for advanced wireless systems.

❖ Working with the JTRS JPO, the SDR Forum adopted the SCA in 2000 as a body of work mature enough to move out to a formal standards body, the Object Management Group (OMG).

❖ Used as a reporting forum where all interested and practicing entities involved with development of software radio standards can gather to network, learn and provide reports and tutorials on latest advancements, related research, start of new and continuation of ongoing related activities, such as related reference implementations.

❖ http://www.sdrforum.org/

The OMG

❖ An international, open membership, non-for-profit consortium that produces and maintains computer industry specifications for interoperable enterprise applications.

❖ Dedicated to producing open interface specifications to promote interoperability within and between multi-vendor computer applications, include real-time and embedded systems.

❖ Publishes and maintains over 100 open specifications, including the CORBA middleware, UML, XML, and now, the OMG flagship, Model Driven Architecture (MDA).

❖ Of particular interest to JTRS and commercial SDR efforts, is OMG's current initiative (since 2000), to produce open specifications for SDR systems, aligned with the SCA and the work of the U.S. DoD JTRS program.

The OMG SBC Domain Task Force (DTF)

❖ Former OMG Software Radio Domain Special Interest Group (DSIG).

❖ With JPO sponsorship in early 1990s, works toward building an international commercial software radio standard based on the SCA and its supplements.

❖ Includes most of the military JTRS contractors, including radio manufacturers, platform integrators, OE, device, service, and waveform developers, and commercial software radio manufacturers and tool vendors.

❖ The group's JTRS members also serve as SCA architects on the SCA TAG.

❖ Most recent efforts include the *PIM & PSM for Software Radio Components Joint Revised Submission* in April of 2004.

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The OMG SBC DTF (cont.)

❖ Involved with continuous development, submission, and responding to Request for Information (RFI)s and Request for Proposal (RFP)s for supplements to this specification that are in parallel to and go beyond the SCA supplements (i.e. the API supplement, the security supplement, etc.).

❖ As requested by the JTRS JPO in late 2004/early 2005, the SBC DTF plans to standardize the _SCA Specialized Hardware Supplement_ at the OMG, once the SHS had reached the desired level of maturity determined by the TAG.

❖ http://sbc.omg.org

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The OMG Software Radio Finalization Task Force (SWRADIO FTF)

- ❖ Chartered by the SBC DTF.
- ❖ Acts as the SCA TAG on the commercial side.
- ❖ Works on the ongoing finalization of the OMG _PIM & PSM for Software Radio Components_ since April of 2004.
- ❖ Much like the task of the SCA TAG, this finalization includes "debugging" the specification, correcting flaws, developing incomplete sections, and providing commercial implementations to exercise the specification and mature the commercial architecture.
- ❖ The SWRADIO FTF includes most of the military JTRS contractors, including radio manufacturers, platform integrators, OE, device, service, and waveform developers, and commercial software radio manufacturers and tool vendors.
- ❖ The group's JTRS members also serve as SCA architects on the SCA TAG.
- ❖ The SWRADIO FTF successfully completed the one-year first-phase finalization of this specification in April of 2005, with the second phase finalization planned to complete in September of 2005, and first revision phase planned to start in December of 2005.

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International Efforts

The JTRS program collaborates with the international commercial arena to lead establishment of the SCA as a recognized international standard for both military and commercial systems. (OMG and SDR Forum activities)

JTRS is also pursuing international activities and multi-lateral efforts to support research and development to enhance interoperability.

JTRS is also working with the North Atlantic Treaty Organization (NATO) Consultation Command and Control (NC3) Board Communications Network Subcommittee and its ad hoc Radio Working Groups to develop new NATO standards (STANAGs) to support future software defined radios.

International Efforts (cont.)

International Agreements

- The Communications Research Center Canada undertook an SCA reference implementation project sponsored by the SDR Forum and Defense Research and Development Canada.

- The U.S. government has signed agreements with Japan, Sweden, and United Kingdom Ministry of Defense for related SCA reference implementations, cooperative R&D program of SDRs, development of SCA-based SDRs, cooperation in interoperability of tactical communications systems

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International Efforts (cont.)

International Discussions

The JTRS JPO has engaged in (SCA/SDR/tactical communications systems interoperability) related discussions with representatives from

- American, British, Canadian and Australian Armies Standardization Program
- Combined Communication Electronics Board (CCEB)
- Multifunctional Information Distribution System (PMOU)
- NATO C3 Board and various sub-committees and working groups
- Australia
- France
- Germany
- Italy
- Netherlands
- Republic of Korea
- Singapore
- Spain
- Turkey

Importance of Involvement of All Stake Holders in Military and Commercial Standardization Efforts

No Off-The-Shelf Standard Exists That Can Satisfy All the JTRS Program Goals

❖ The JTRS programs require communications systems that are interoperable, whose components are portable, interchangeable, and reusable, with an architecture that is scalable from handheld platforms to base stations.

❖ Additionally, the architecture is to be open, common, distributed, embeddable, object-oriented, language independent, and platform-independent, supporting security for systems that require cryptography.

❖ There is no standard out there that completely satisfies all of the above needs.

❖ The JTRS SCA specification and its supplements are fairly new and have not matured yet, as they go through continuous "debugging", maturation, and development in the context of supporting ongoing military production contracts such as JTRS Cluster 1 and FAB-T.

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Best Candidates to Work Toward Maturing the Specification in the Military Sector

JTRS SCA architects, designers, engineers, implementers, testers and integrators with the experience of having implemented the specification in the context of production programs, as they have to use the specification for manufacturing a production radio with production version of the SCA OE and new and legacy waveforms exercising and exhausting the full capabilities of the SCA OE, API, and Security supplements, and pin pointing areas of the specification that are ambiguous, undeveloped, or incorrect, and hence are left open to interpretation, minimizing the goals of portability and interoperability.

Importance of Commercial Standardization

To make the goal of the worldwide interoperability of communications systems a reality.

Best Candidates to Work Toward Maturing the Specification in the Commercial Sector

Involvement of all commercial software radio vendors including cellular vendors is crucial to ensure the commercial specification is headed in the right direction to meet the needs of the commercial market.

Involvement of JTRS SCA Architects is also crucial, since

- The commercial version of the Software Radio Specification is SCA-based, and hence, the experience of these architects in its maturation is crucial, and...
- It is important to keep the military SCA specification and the commercial software radio specification in sync as much as possible.

Involvement of Military and Commercial Stake Holders Goes Beyond the Need of Simply Having a Better Specification

Such involvement is need for correct contractual performance as well as product delivery.

In order to develop to a specification, one must first understand it.

In order to develop to a maturing specification, one must have first hand involvement with the definition, development, maturation, and maintenance process for that specification.

Without such involvement, the company will not have the necessary technical expertise, visibility and insight to produce the needed product with the needed vision for inevitable future upgrades.

Through working on the very specifications that govern current and future everyday work on both the military and the commercial side, and collaborating with other SCA and SDR architects that have authored sections of these specifications, group members gain more insight and understanding into specifications that can be very hard to understand and often seem ambiguous even after months of reading.

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Involvement of Military and Commercial Stake Holders Goes Beyond the Need of Simply Having a Better Specification (cont.)

Involvement with the OMG's commercial SCA and SDR and related task forces is crucial not only for the better comprehension of these specifications, but also, for understanding the OMG platform standards technologies that companies have to come up to speed with sooner or later as the military and commercial SCA specifications merge.

These include UML 2.0, MOF, OCL, and MDA, understanding of all of which is crucial for understanding the OMG SCA-based SDR specification, as the specification is directly expressed using these standards and technologies.

Conclusion

Conclusion

Every company should dedicate several SCA/SDR savvy engineers and architects to be involved with the SCA TAG and the OMG SBC standardization efforts, industry tutorials, and building related prototypes to show implementations that prove the standardized architecture.

Involvement in and proper customer and contractor funding for the military as well as commercial SCA and SDR standardization efforts through the SCA TAG and the OMG SBC DTF and the OMG SWRADIO FTF are crucial for accepted performance on current JTRS and commercial contracts, competing effectively for future contracts, and ultimately, making the goals of the JTRS program as well as the commercial worldwide SDR industry a reality.

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❖ JTRS International Standardization Efforts, http://jtrs.army.mil