Driving Lower Cost and Faster Capability Deployment

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Why are we here?
- Some of the key challenging problems.

How can we meet these challenges?
- SDR technology and standardization.
- Software Communications Architecture (SCA).
- Realizing “true” International SCA Standards via the WInnF Coordination Model.
- Application of Software Product Line (SPL) Techniques for SCA Solutions.

Where do we go from here?
- Conclusions.
The Challenging Problems

- Interoperability
  - Incompatible equipment and frequency bands.
  - Lack of cooperative agreements.
  - Lack of training.
  - Institutional control and culture.
- Latency and cost of technology insertion.
- Information Assurance (IA) and security for sovereign and coalition operations.
- Operational complexity.

*Interoperability is a fundamental issue, but other aspects are also critically important.*
SDR Technology and Standardization

SDR Technology

assuredcommunications™
Benefits of Open SDR Standards

- Enabler for interoperability, procurement clarity.
- Platform knowledge sharing.
  - Reduce costs and risks associated with innovation through the collective brainpower and investment of:
    - Industry (defense, public safety and commercial providers)
    - Governments worldwide
    - Academia (i.e., Virginia Tech, Karlsruhe, Stevens Institute)
- Facilitates software reuse.
  - Reducing development costs and product time-to-market.
  - **Build less software, reuse proven existing applications.**
- Market competitiveness.
  - Facilitates technology insertion, third-party participation.
- Development and integration of advanced applications.
  - I.e., situation awareness, dynamic spectrum allocation
What Makes a Standard Open?

- **Not** proprietary.
- Readily available, published specifications.
  - Includes all elements of the standard (i.e., APIs).
  - Change management (i.e., backwards compatibility).
  - Promotes development / availability of tools suites.
- Formal, accessible, affordable and timely test, evaluation and certification process.
  - One or more certified (validated) implementations providing proof that the standard can be implemented.
- Extensibility, ability to evolve with future demands.
- Broad acceptance across industry, Government and relevant user space.
U.S. DoD Key SDR Objectives

• Enable programmable radios to load waveforms, run applications, be networked into an integrated system.
  – Programmability preserves HW investment
  – Reduces cost and time-to-market for SW based capabilities.
• Procurement clarity – setting & meeting expectations.
• Software reuse and waveform portability.
  – Ensuring interoperability among all JTRS products, including across different radio form factors and missions.
  – Provide needed communications capabilities while reducing the time-to-market, maintaining overall system affordability.

Manage growing complexity of interoperability with leaner budgets
Software Communications Architecture

- Developed by the U.S. DoD as part of JTRS Program.
- Open architecture framework that defines a set of rules and protocols for SDR platforms.
- CBD technology provides “Interchangeable SW parts”.
- APIs facilitate waveform portability across radio sets.

Waveform Applications

- SCA Operating Environment (OE)
  - Services and Devices
  - Core Framework (CF)
- POSIX Operating System / CORBA Middleware
- Board Support Package (BSP)
- Radio Set Hardware

Platform Software

APIs
SCA and Military SDR Evolution

3rd Gen ++

SCA Compliant (Worldwide)

Standard Software Architecture (MSLOC+)

3rd Gen

SCA Compliant (USG)

Standard Software Architecture (MSLOC+)

Software Defined

2nd Gen

Vendor Specific HW/FW/SW Architectures (MSLOC)

Programmable

1st Gen

Vendor Specific HW/FW Architectures (KSLOC)

Hardware Only

Vendor Specific Hardware Architecture
SCA Current State in the U.S. DoD

- U.S. DoD “Enterprise Business Model”
  - JTRS products built on common standards and specifications, DoD and commercial standards.
  - “Open source” type environment with GPR.
  - Information Repository (IR) of verified reference model implementations (base waveforms), artifacts, T&E results.
  - Formal Change Management (CM) controlled by US DoD.
  - SCA Specification 4.0 released in March-2012.

- Radio product platforms developed with SCA compliant Operating Environments, standard APIs.

- Waveform application reference implementations are ported onto radio product platforms.
  - Ported implementations (target waveforms) stored in IR.
SCA Activity Beyond the DoD

- Wireless Innovation Forum (WInnF)
  - Elevates SCA activities to Committee level
  - Defines “Coordination Model” for SCA Standards.
  - International Radio Security Services API.
- EDA proposes “Three Category Approach” for API standardization; WInnF votes approval of approach.
  1. International open standard, unlimited distribution.
  2. Multi-national interests (i.e., coalitions), limited distribution.
  3. Specific national interest (i.e., national security), controlled.
- ESSOR program adopts of SCA v2.2.2 baseline.
  - Developing candidate set of extensions and new capabilities.
- Other national programs; Academia; Commercial tools.
Information Assurance and Security

• Key considerations in waveform porting.
  – Required IA and security capabilities, including connection to open networks and policy based re-configurability.
  – Waveform applications partitioning across security boundaries.

• Multi-surface model concept:
  • Facilitates open standardization and protected interests.
  • Transformation layer can uniquely and securely alter information format and content.
  • Private APIs (national or coalition) exposed only where applicable.
  • WImnF IRSS API solution.
Waveform Application Porting

• What is it?
  – “Transformation” of an existing waveform software application so the resulting waveform software will execute properly on a new platform.

• **Facilitated by basic principles of the SCA.**

• Key Considerations
  – Development is complex.
  – Waveforms extend throughout radio to system level.
  – Waveform processing is distributed:
    • Multi-processors, multiple processes, multiple processing threads on a single processor.
  – Requires application of real-time design concepts.
  – Integral with communications security considerations.
Harris Waveform Porting Experience

- 2nd generation waveforms (SINCGARS, HPW, IW)
- Third party waveforms (APCO P25, DAMA)
- IP based networking waveforms (ANW2, SRW)
- Information Repository waveforms (HQ, VULOS)
- Multiple platform domains
  - Man-Pack, Hand-Held, Small Form Factor
  - Multi-channel vehicular, shipboard, airborne
  - LMR
  - Other.
- Multiple products, including various hardware architectures and frameworks.
Waveform Porting Examples

- Initial Development
- Port #1
- Port #2
The Path to Broad SCA Standards

Realizing “true” International SCA Standards via the WInnF Coordination Model
Coordination Model Key Objectives

- **Harmonization**: Support technical collaboration across various organizations in order to harmonize SCA specifications worldwide, as much as possible.

- **Roadmaps**: In partnership with relevant stakeholders, define, maintain and publish technical roadmaps for evolution of SCA specifications.

- **Distribution**: Provide a central authority for collecting and distributing publically released specifications from various organizations worldwide.

- **Support**: Provide guidance and help to procurement authorities, implementers and testers to ensure consistent interpretation specifications.
Leverages and preserves program investment, economies of scale for cost and time.
Conceptual Draft
• **WInnF** is the **ONLY** worldwide organization with necessary capabilities to realize coordination value.
  
  – **WInnF** represents 100’s of staff-years of military defense communications with specific SCA experience.

  – Established relationships with all key stakeholders, including Gov’t representatives on Advisory Council.

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From Standardization to SW Reuse

Application of Software Product Line Techniques for SCA Solutions
Software Product Line Techniques

• **Software Product Line (SPL):** A portfolio of similar software systems developed from a common set of shared assets in a prescribed way (i.e., common means of production). [SW PLATFORMING]

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**Software Assets**

- **AN/PRC-152A**
- **RF-310M-HH**
- **RF-7800M-HH**
- **AN/PRC-117G**
- **RF-7800M-MP**

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**Falcon III® Radio Family**
Falcon III® OE SPL Examples

• Capabilities added (includes technology insertion)
  – OE updates to support SRW V1.01.1C.
  – USB transceiver updates.
  – SCA v2.2.2 compliance updates.

• Observations
  – Radio Product #2 main focus = build, testing and verification.
  – SCA v2.2.2 costs higher to include JTeL preparation and support (with travel).
Where do we go from here?

Conclusions
Conclusions (1 of 2)

- Interoperability, development cost, time-to-market, security are critical issues facing military communications stakeholders.
  - Being addressed today through SCA enabled technologies.
- The JTRS SCA provides a foundation to mitigate interoperability, cost and time-to-market challenges.
  - Standardization provides path to assured compliance.
  - Architectural separation through defined Applications Programmer Interfaces (APIs) facilitates cost effective waveform application porting.
  - Enterprise business model facilitates reuse.
Conclusions (2 of 2)

• WInnF Coordination model extends these benefits past the U.S. DoD into the global space.
  – Provides full eco-system of support across portfolio of SCA specifications; preserves and leverages investment.
  – World-wide organization with sufficient breadth of experience in military defense communications and SCA.
  – IRSS API framework supports three category approach with a standardized security solution.

• Software Product Line (SPL) techniques
  – Can be applied to families of SCA based products to drive down development costs and reduce time-to-market (capability deployment).
  – Software Platforming supports rapid technology insertion.
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