Business Models for new entrants in SDR Tactical Radio Market

Market Report - 2015

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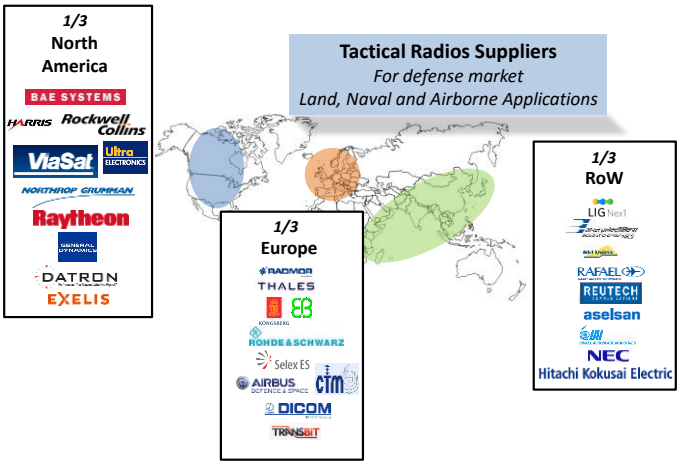
1 Introduction

The Wireless Innovation Forum published a market report in 2013 on Business Models for New Entrants in the SDR Tactical Radio Market.[1] Since the initial publishing of this market report by Forum members, multiple market activities have taken place highlighting the need to update the report.

The International Tactical Radio Special Interest Group from the WInnForum Coordinating Committee on International SCA Standards, has identified nearly 30 suppliers worldwide developing and producing tactical radios for defense market for land, airborne and naval applications. A majority of these companies are introducing SDR capable solutions together with adoption of SCA standards.



The introduction of SDR generation opens new possibilities in terms of business models. Additional companies are also playing roles in the new SDR value chain such as integrators or modules providers.

In the past two years, the market has undergone the following changes:

- in the U.S., the business model has evolved from the JTRS program to the SDR radio marketplace with a radio platform MOTS[2] approach,
- the SCA standard and associated APIs are recognized as enablers of SDR business models:
  - through currently deployed systems such as number of radios, number of suppliers, worldwide programs using the standards, and
  - through the recent U.S. procurement process mandating SCA standard.
- The SCA 4.1 release is being introduced, bringing important benefits to the whole value chain: industry, programs procurement, and end users.

Waveforms are at the heart of the various SDR business models, and are among the main parameters of the SDR programs. Waveform Portability is among benefits of the usage of the SDR architecture standard.

The main focus of this report is to highlight key updates on the market of SDR tactical communications as well as provide new views on SDR business models though the introduction of new examples highlighting usage of the SDR standard together with deployment of a waveform centric approach for the network centric operations transition.

[1] Reference Document WINNF-13-P-0001 Business Models for New Entrants in the SDR Tactical Radio Market, available at www.wirelessinnovation.org

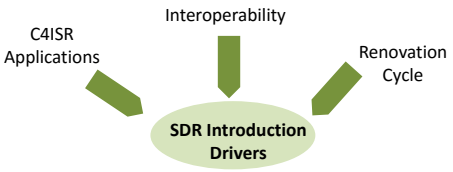
[2] MOTS: Military Off the Shelf

2 Toward a Waveform Centric Model

2.1 SDR Drivers, a Review

The previous report described the main drivers for introduction of SDR technologies in the defense tactical communications market that could be analyzed through two different axes:

1. the introduction of a new generation of networking waveforms with some MANET features and High Data Rate capabilities. Such waveforms request new generation platform, therefore driving introduction of new generation systems based on SDR, and
2. market driver and end user requirements with advanced services in terms of C4ISR capabilities as well as improving interoperability between services at national/joint or international/coalition level. (See Example of Italia Forza NEC program in Annex 11.)



Acquisition cycles also influence SDR adoption. The tactical radio cycle is estimated around 25 years for the land domain, with possible intermediate refresh milestones. This cycle is also influenced by the system or the platforms life cycles such as armored vehicles as well as air domain through airborne platforms integration and qualification.

2.2 Waveforms as the Cornerstone of SDR Generation Introduction

Waveforms pave the way of the future of Tactical Communications[3]

- The introduction of new interoperability and coalition/international waveforms is a main concern in U.S. and in European nations. Adequate SDR architecture, Waveform development and porting methodology should be used to ensure that SDR platforms from different origins (suppliers, national security solutions) can support and operate the waveform. Multiple initiatives are ongoing covering wideband and narrow band capabilities (ESSOR, COALWNW, NATO – NB & WB).
- Introduction of new wideband networking waveforms with secured MANET and with high data rate capabilities drive the introduction of the new SDR platform capable to support such processing requirements.

- Nations are looking for sovereignty and independence from radio platform vendors. National waveform programs can ensure interoperability between different radio vendors.
- Future tactical communications architecture relies on various radios and waveforms capabilities. The current existing generation (CNR, narrow band waveform) will continue to evolve with key enhancements, such as improved networking and higher spectrum efficiency for higher data rates.
- The transition will also have to manage interoperability with legacy waveforms, i.e. currently used (i.e. previous generation) waveforms without evolutions (or with very limited evolutions).

SDR Business Models should be based around waveforms and should secure the porting into platforms of different origins and types with:

- Different suppliers
- Different types (Vehicular, Handheld, Airborne etc..)
- Different generations

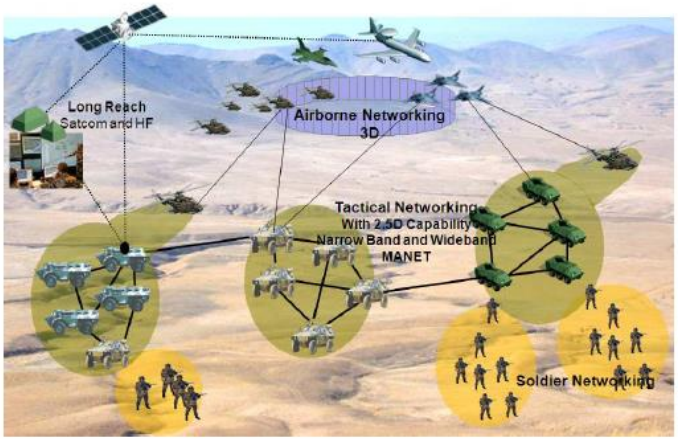
2.3 NCO Tactical Communications Architecture

The Network Centric Operations (NCO) transition requires introduction of new networking waveforms addressing higher data rate capabilities and integration into a complete theatre tactical communications architecture.

[3] Waveform Portability Workshop – WINNF – Paris January 2014 – Thales Keynote

The design of networking waveforms is driven by a set of physical constraints (such as physics, electronics, processing power, form factors) as well as of course by end user requirements for operational capabilities, performance level and regulations. More precisely, elements to be considered when defining a waveform include for example:

- type of usage: ground static, ground mobile, airborne, ground to air, air to air, either 2,5D or 3D, etc.,
- expected end user application such as command & control, close air support, radio-based combat identification (for friendly fire avoidance), and intra flight communications, and
- desired level of performance: based on trade-offs such as range/throughput/robustness, electronic protection measures, level of quality of service, etc.



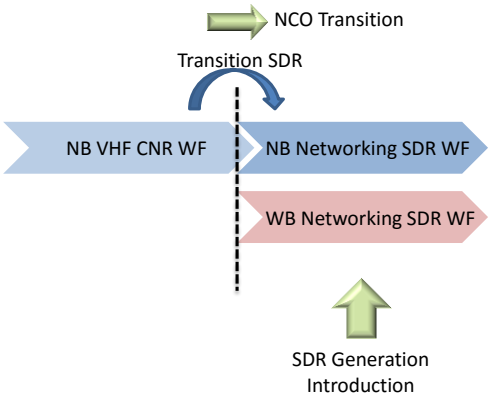
Taking into account the new capabilities requirements and the various constraints for waveform design, there is no single waveform to answer NCO transition requirements. Typically, the following waveform capabilities are required in such an approach:

- narrow band (25 kHz channelization or multiple) and wideband (from x100kHz up 5MHz channelization) networking capabilities for ground forces in frequency bands from VHF up to 2GHz. These waveforms are fully secured with advanced ECCM capabilities to address segment from battle group down to company or platoon.
- Soldier Networking Waveforms
- Airborne Networking Waveforms
- Data Links

2.4 Land Domain: From existing Narrow Band to NCO

New generation ground tactical communications architecture will rely on a mix of narrow band waveforms running in preferred VHF band providing good tactical communications range (i.e. in the range up to 30kms) but with reduced throughputs capacities (i.e. in the range of several 10' kbs) along with wideband waveforms running in preferred UHF band providing additional spectrum to run larger channelization waveforms providing throughputs capacities up to Mbs, but with a reduction in range (i.e. in the range up to 10 kms).

Military forces are increasingly dependent on transferring large amounts of data. The digitizing of weapons platforms and data collection devices (sensors) has led to the production of large quantities of data. These data need to be collected, transferred, processed and analyzed in order to be relevant for decision making. The challenge is to secure the appropriate amount of bandwidth on different levels of command. In addition, the number of units to be equipped with military radios[4] is increasing. Spectrum is a scare resource, especially for the dedicated military applications, with more and more frequency resource requests coming from commercial wireless usage. As a consequence, the NCO tactical communications architectures should also rely on the new generation VHF networking capabilities.



If wideband networking waveforms are, in general, new waveforms (developed in parallel of SDR radio generation development and introduction into the field), the narrow band

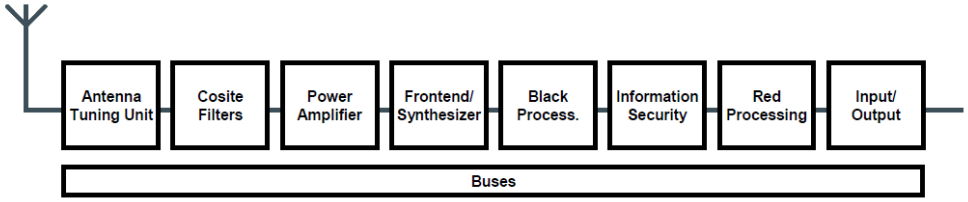
[4] Article National Guard Magazine – September 2014 – Continuing Legacy.

networking capabilities could be a natural evolution from existing radio generation (sometimes labeled and referred as legacy), CNR VHF.

2.5 Compatibility of SDR Waveforms and SDR Platforms

2.5.1 Reminders

The compatibility of an SDR waveform with an SDR platform has been examined in the WINNF document "SDR Technologies for the International Tactical Radio Market" Document Reference WINNF-09-P-0006 V1.0.0".[5] It reviews in particular the key aspects of SDR platforms and limitations regarding waveform portability depending on radio platform features. The SDR Platform consists of all the hardware that encompasses a radio in addition to the platform software. A given waveform application principally shall be able to execute on the radio platform. The following figure extracted from the previous report illustrates this.[6]



Compatibility and portability feasibility should be examined in terms of:

- processing Capabilities
- SDR Architecture (standard, APIs)
- modem architecture (allocations of resources onto processing resources types: GPP-FPGA-DSP)
- security Architecture
- RF Capabilities (Bands, Channelisation etc...)
- RF Performances

The portability feasibility and effort is highly dependent on this checklist. SDR Architecture standard is only part of this cost.

2.5.2 Introduction of Wideband Networking Waveforms

New wideband and high data rate networking waveforms usually require new platforms introduction through:

- important processing requirements: data throughputs are now in the range of Mbs compared to 10'kbs in previous generation ;
- networking protocols, new RF technologies like DPD, dynamic resource allocations etc.. are requesting as well important processing capabilities increase.

All introductions of new waveforms (SRW, WNW, ANW2, FlexNet, ESSOR-HDR etc.) are done on new platforms or on platforms designed to support such capabilities.

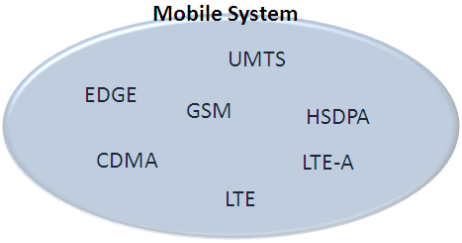
2.5.3 From Legacy to SDR

The management of the "Legacy" (ref to § 2.4) is key to ensure the success of SDR through its introduction in tactical communications architecture of end users. Depending on the national context, the transition strategy can be different. For instance the U.S. Army uses an incremental architecture roadmap Capabilities Set (CS) (ref to §3.5.2). In the commercial mobile solutions, the mobile system

[5] Reference document available at www.wirelessinnovation.org

[6] Figure 8 – Principal Hardware Structure of a Radio

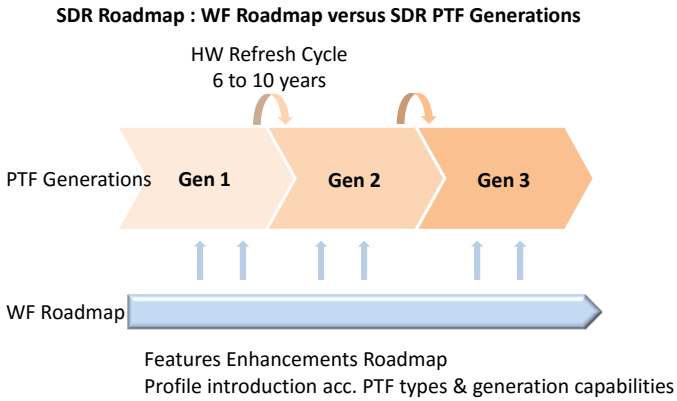
deployed by each operator is capable management of multiple access technology generations, maximizing the services capabilities for each device type. In a similar way, introduction of a new generation in military tactical communications can be managed with some system approach.



On the contrary, introduction of SDR generation with capabilities inherited from legacy waveform capabilities (i.e. implementation of legacy waveforms into new SDR) can be debated. Why invest to have the same capability as in the past ? Therefore, a smart approach with the capability to interconnect legacy with a more capable radio (SDR generation) should be favored to justify new investment. Transition strategies have been presented in some conferences such as the France Contact program[7].

2.5.4 Waveform and Platform Lifecycles

Introduction of SDR technologies and WF-centric models provides the benefits of SDR PTF capability enhancements derived from processing capabilities improvements (Law Moore) or RF technology improvements. It mainly drives enhancements in terms of SWAP for SDR Platforms. Common waveforms, with intelligent profile introduction, can be run into different SDR Platform generations.



Also, as reported in the previous reports, the SDR technologies usage enables easy SW upgrade to provide regular waveform enhancement capabilities to warfighters. "*Today's tactical radios are uniformly software defined, offering the ability to introduce changes and upgrades in the field.*"[8]

The rapid evolution of SDR platforms is well reported in the press. With an example reported by Thales in a recent C4ISRNET article. "*The radio of yesterday hosted a single waveform, weighed seven pounds and had a maximum power output of five watts," Tom Kirkland, Senior Director of DoD programs and pursuits for Thales Defense and Securities, noted. "Today's most advanced handheld radio, the MBITR2, weighs two pounds, provides two simultaneous channels, hosts 10 waveforms and provides five watts of power output on both channels.*"

2.6 Interoperability

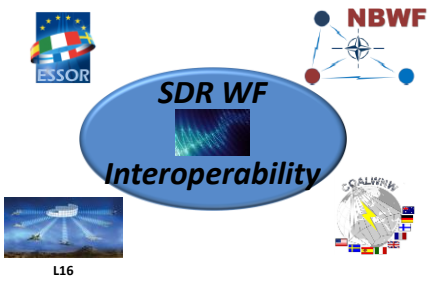
At first we have to distinguish two levels of interoperability.

- National level between different forces, sometimes called joint operations. For instance, interoperability between Army, National Guard, Marines, Airborne forces, Naval forces etc…

[7] CONTACT Program: from SDR Promises to reality – WINNF Tactical Communications Workshop – Roma – November 2014.

[8] Tactical radios evolve to meet a new world of demands, C4ISRNET, 19th December 2014

- International level to conduct international coalition operations.



NATO has already launched and developed multiple standards to permit interoperability of forces into the battlefield theater. Among the main noticeable success are:

- HF standards and the HF house
- tactical data links, such as Link 11,
- satcom,
- ground-air waveforms, such as Havequick or Saturn

More interaction at the tactical edge evolving toward mobile networking capabilities and increasing data capabilities to cope with need to exchange more and more information, and introducing the latest generation of C4ISR applications push to introduce some new interoperable solutions is in order to share the Common Operating Picture.

Four main waveforms programs can be given as international efforts:

- ESSOR HDR Waveform led by the ESSOR Program,
- COALWNW Waveform program, led by an International Program Office (IPO),
- NBWF, NATO NB Waveform, led by a NATO standardization WG, and
- L16, led by an International Program Office (IPO).

These programs are at different maturity levels, i.e. from early stage or acquisition strategy discussions up to operational usage.

3 SDR Programs overview, what's new since 2012

3.1 Overview

Since the last report edition, multiple updates occurred in the SDR market for tactical communications, showing a growing adoption of the technology through deployment of systems and also launch of new programs in the international market.

The U.S. market, since the transition of the JTRS program, has evolved toward a new business model, waveform centric with acquisition of SDR Platforms in a so called "Radio Market Place", ie based on NDI[9] radios rather than on radios derived from POR[10]. SCA standard is mandated in the new tactical radios procurements (See details in §6.2).

In Europe, the development of the ESSOR HDR Waveform is progressing with first demonstrations occurring in 2013-2014. The new step of the program, named Operational Capability 1, aiming to test the waveform on the field (with interoperability) is under negotiation. Beyond the French SDR Program, Contact, launched in 2012 and that is the largest SDR program on going (outside US), some new programs have been launched or are in considerations. For instance Poland has launched its Guarana Program.

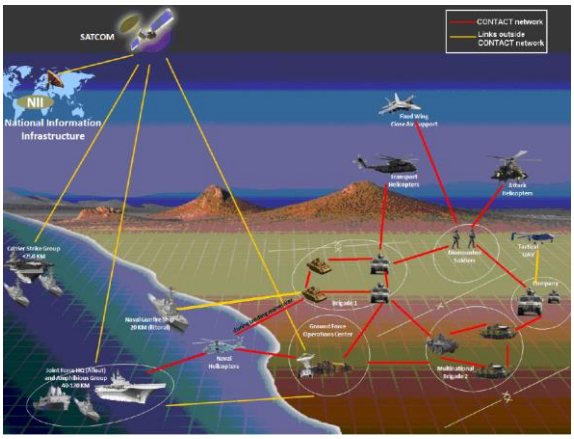
SDR Programs expansion is not only limited to North America and Europe. Asia-Pacific, Middle-East and Latin America are also SDR players with their on-going programs. We can for instance list, Brazil, India, Israel, Japan, Singapore, South-Korea, Turkey, UAE.

3.2 What's new in Europe

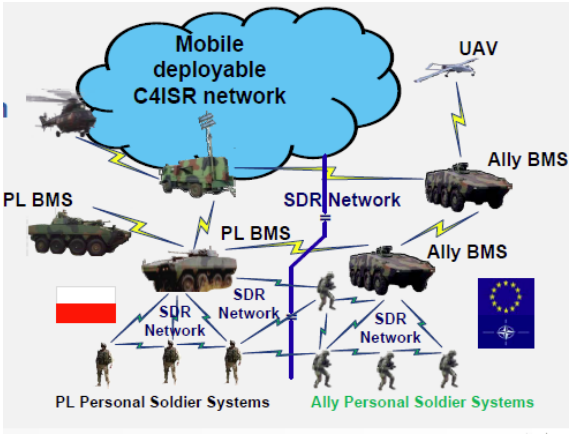
Large **France** SDR Program Contact launched in 2012 represents the largest investment in Europe in the SDR domain. It is a Multi-Waveforms (including ESSOR HDR Waveform as interoperability waveform in coalition), Multi-Platforms (different SDR Platforms are procured: Vehicular, Airborne, Dismounted, etc...) and Multi-Domains program (not only land domain, but also airborne and naval domains including interoperability between domains).

[9] Non Development Item

[10] Program Of Record



Contact Program



Guarana Program

Poland launched its National SDR Program in 2013, called Guarana Program relying on National Industry[11].

After the TDRS Program under deployment (FlexNet by Rockwell-Collins[12]) **Sweden** issued an RFI in 2013 related to the TGRS Program including SDR technologies (platforms and waveforms). The acquisition strategy is based on a MOTS Approach.

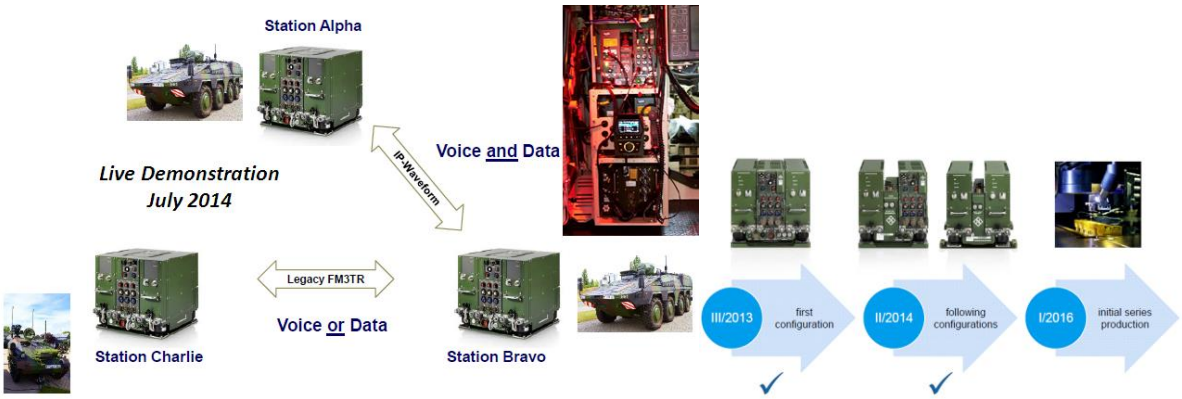
SDR Introduction is also driven by the tactical communications renovation cycle. Accordingly, mid to long term renovation programs driving needs for SDR technologies are under preparation. Among them are:

- **UK**, paving road of the LeTacCis program and
- **Norway**, introducing the long term P8043 program aiming to renovate tactical communications

Other national programs, already launched and reported in the previous edition are progressing into their developments and deliveries.

- **Germany** SVFuA, started in 2009

Some progress information has been made public during the 4th International Tactical Communications Workshop organised by the Wireless Innovation Forum. First demonstrations were conducted in July 2014 with radios integrated into armored vehicles. The program is continuing in 2015 and 2016, with further integration of waveforms and planned initial serial production in 2016.



11 SDR Europe 2013

12 Press Release – Rockwell-Collins 15th September 2010 - Sweden's Defence Materiel Administration (FMV) selects FlexNet-Four radios for Tactical Data Radio System

- **Italian** SDR Programs

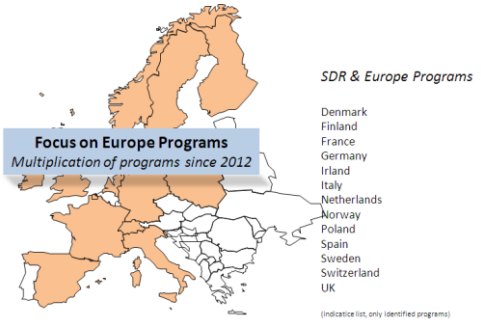
The national Italia SDR Program is made up of the following programs (or part of):

- Future Soldier
- Land Program Forza NEC
- Naval Program

Selex ES has issued a Press Release[13] on Future Soldier highlighting the contract for delivery of SDR Handheld radio in the frame of this program.

In the 4th International Tactical Communications Workshop, the Italian MOD provided an updated procurement scenario / roadmap for SDR tactical communications.

Concerning the **ESSOR Program**, whose business model aspects will be further addressed later in this document, the first demonstration was performed in 2013, and further interoperability tests are ongoing. Multi-platform (multi-supplier origin) interoperability tests are progressing as reported by OCCAR in the ESSOR Program web page (December 2014 interoperability tests session[14]).



More than 12 countries are identified as having different programs (development or acquisitions, on-going or under Request for Proposal) in Europe.

3.3 SDR Programs Beyond U.S. or Europe: What's New

Beyond U.S. and Europe, the list of countries involved or interested in SDR programs for defense is increasing. As of today we have identified Brazil, Canada, India, Israel, Japan, KSA, Malaysia, Singapour, South-Korea, Turkey, and UAE.

Main evolutions compared to the previous edition of this report are:

[13] PR Selex ES – 25th March 2014 - Selex ES signs new contracts worth around €60m for the Italian Army's "Soldato Futuro" program - http://www.selex-es.com/-/sdr-italian-army

[14] First successful interoperability qualification testing in the ESSOR Program – Dec 2014: http://www.occar.int/333

- **India**
  Three domains: Airborne, Naval and Ground tactical communications. The first phase of the India Air Force SDR program was awarded in 2014.
  The role of the Indian industry is increasing in SDR technologies, both for platforms and waveforms.

- **Brazil**
  A national program started in 2013, led by the National Industry.

- **South Korea**
  Progress in the TICN/TMMR programs and first prototypes exhibited (prototypes from LIG Nex1 at right).

- **Japan**
  Land[15] and Naval SDR Programs are ongoing using SCA technology.

3.4 International Market: New products introduced in 2012-2015

Since 2012, the market has seen the introduction of several new solutions.

- Introduction of a **new generation SDR in U.S.** driven by the U.S. Army FRP acquisition and by SOCOM STC requirements. (See **§3.5.3**)
- In Europe, the launch of national programs like CONTACT in France, or Guarana in Poland, or the planned launch of the next phase of the ESSOR Program will drive the availability of a new generation of products by end of the decade.
- **Multiplication** of solutions available today in the market reflected by the analysis of the SDR Platform offered in this report (See §3.7).

The Annex 10 shows a few examples of new solution on the international market.

3.5 U.S. Market

3.5.1 Trends in U.S. Markets

Over the past two years, the U.S. market featured some important evolutions, creating an uncertain marketplace in general and impacting the tactical communications and SDR markets.

Main areas impacted include:

- Operationally, the end of major ground operations in Iraq and Afghanistan and the emergence of new geopolitical priorities which are major drivers for requirements definitions and procurements planning.
- In terms of budgeting, uncertainties such as budget cuts and sequestration have seriously impacted the procurement tempo.

Nevertheless, the digitalisation and networking priorities remain. Some new 2025 networking vision has been set up by PEO C3T and released in Q1 2014[16]. The deployment of SDR radios embedding some new networking capabilities (provided by networking waveforms) together with CS 13 and CS 14 communications architecture has started, including deployment in operational conditions in Afghanistan.

On the acquisition side and SDR Program organisation, the responsibilities among different organisations have been reshuffled and an SDR marketplace has been promoted.

[15] See article Wall Street Journal – 26th November 2013 - Meet NEC, Military Equipment Vendor

[16] www.army.mil – 20th March 2014 - From '1984' to 2025: Army, industry focus on next-generation network

In this context, the importance of SCA and other SDR standards (such as APIs) has been confirmed. These standards are now referenced in U.S. DOD DISR and they are included in new Radio procurements[17].

John McHale, from Military Embedded Systems magazine, in an editorial "U.S. military market is a sustainment market,"[18] highlights the importance of COTS trends in such market context.

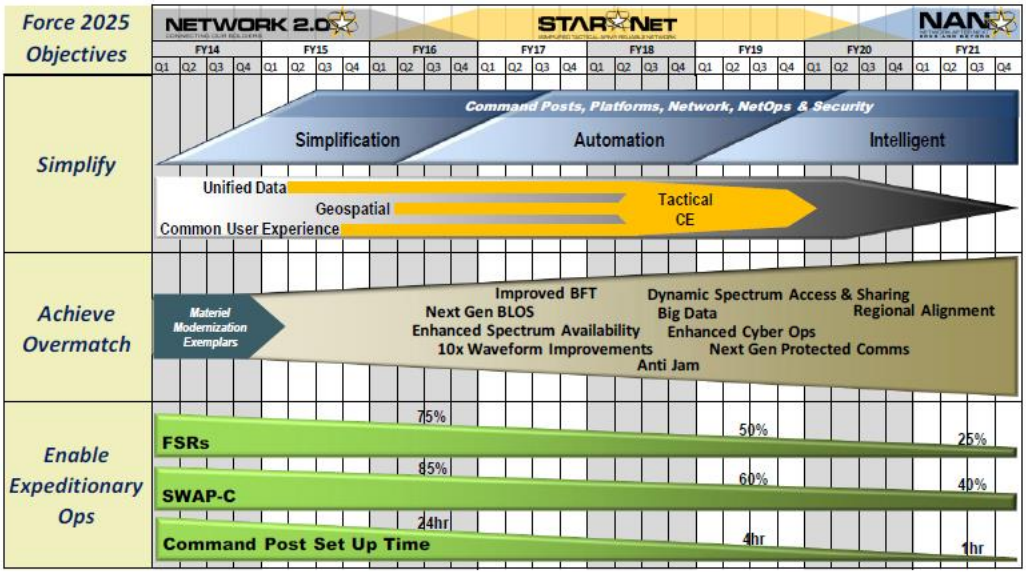
"Market analysts and distributors of electronic components don't see it so much as a shrinking market, but rather one that is evolving and shifting toward sustainment. (…) Sustainment and modifications are typically green lights to suppliers of commercial off-the-shelf (COTS) hardware and software as most upgrades want to leverage open architectures and open standards. (…) This is absolutely an opportunity for COTS suppliers. Proprietary is not what the government wants anymore. They want mature commercial stuff with open standards that can be easily integrated and refreshed.(…) COTS and open standards are also driving factors in military communications and networking applications."

3.5.2 Networking Roadmap: Toward 2025

The Next Generation Network Initiative, « Future Network » was launched at the Tactical Network Industry Seminar in March 2014. It provides vision from today through 2025 highlighting the Army's priority to simplify network and mission command capabilities to make it easier for soldiers to get information they need anytime, anywhere, and on any device with less training required.

The Network Modernization Roadmap is built with 3 phases:

- Network 2.0: FY14-15
- STARNet – Simplified Tactical Army Reliable Network - FY16-20
- NaN– Network after Next - 2020 and Beyond



Networking Roadmap[19]

[17] Rifleman Radio Procurement RFP, Man Pack, STC RFI

[18] U.S. military market is a sustainment market, John McHale, mil-embedded systems, October 2014 and Tactical Communications Workshop, WINNF, Roma November 2014

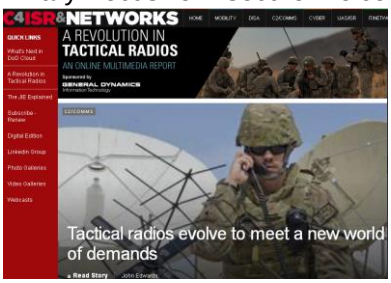
[19] Networking Roadmap – PEO C3T Presentation at SCA 4.1 Pre-View Workshop Organized by WINNF and JTNC, Aberdeen 9th October 2014

This vision relies on continuous injection of new technologies into the Army network. Based on some key operational performance indicators to be improved such as field support requirements, SWAP and cost, and deployment time, the vision drives capabilities improvement roadmap that include performances related to SDR, platforms and waveforms.

Currently the Army is deploying Capability Set (CS) architecture with CS13-CS14 releases under fielding and subsequent releases afterward.

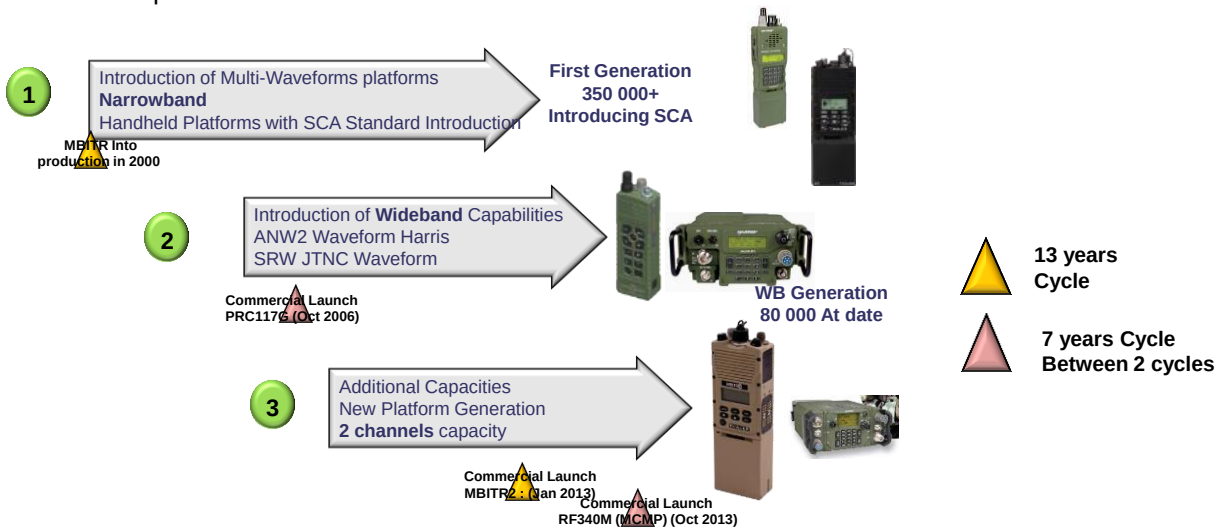
3.5.3 U.S. Radio Deployment Status for Land Forces

The tactical radios used for decades were primarily single purpose, narrowband systems. "They were designed to address a specific mission or use case with a primary focus on secure voice communications," said Tom Kirkland, senior director of DoD programs and pursuits for Thales Defense and Securities in Clarksburg, Maryland. Today's radios, however, can now accommodate multiple waveforms and channels on a platform as small as a handheld device. "They are able to simultaneously provide secure voice, Position Location Information (PLI), application data and ISR data," Kirkland observed. "The soldiers at the edge today are capable of having the Common Operational Picture (COP) at their fingertips."[20]



For Land Forces SDR radios, we can already identify three generations or three generation platform cycles.

- The first is related to the introduction of Multi-Waveforms Platforms, with narrow band capabilities and introducing SCA.
- The second is the introduction of wideband capabilities including MANET waveforms.
- The third is a new cycle with SWAP improvements and with introduction of bi-channel capabilities in a compact format.



In terms of quantities (refer to Annex for calculation details):

- First Generation: NB capabilities: 350 000+
  Mainly AN/PRC-152 and AN/PRC148 product families
- Second Generation: WB capabilities: ~80 000
  AN/PRC 154 and AN/PRC-155: ~25000
  AN/PRC-117G, 152A product families: ~55000 units

[20] Tactical radios evolve to meet a new world of demands – C4ISR & Networks – 18th December 2014 - http://www.c4isrnet.com/story/military-tech/communications/2014/12/17/tactical-radios-new-world/20545229/

3.5.4 Radio Platform Acquisitions

Procuring Non-Developmental Item (NDI), or commercially-developed, products rather than investing governmental development resources opens competition to industry partners. This creates a radio marketplace that will encourage vendors to deliver superior radios at lower costs.[21] U.S. PEO C3T is leveraging the NDI approach into various procurement programs:

- Land Forces Tactical Radios
  - **Rifleman** Radio
    The U.S. Army has released the final version of its awaited RFP for the Rifleman Radio beginning 2015[22], putting into practice the new radio marketplace business model. After LRIP contracts for former HMS JTRS PoR radios (AN/PRC 154), in total more than 21,000 radios, the RFP aims to select multiple vendors for the FRP of Rifleman radios supporting SRW Waveform. The FRP would begin in FY 2017 and the Army's total acquisition objective is more than **190,000 radios**.
    The U.S. Army announced on 29 April 2015 the selection of two radios for this RFP, from Harris and from Thales.[23]

  - **Manpack** Radio
    
    Manpack Radio is the U.S. Army's first two-channel SDR capable of supporting new networking waveforms and current existing waveforms. Through LRIP, the U.S. Army has already purchased 5,326 Manpack Radios from PoR program (General Dynamics and Rockwell-Collins) (AN/PRC-155), which have been fielded to BCTs as part of CS 13, including some deployed to Afghanistan in February 2014. The U.S. Army will continue to field the Manpack to select BCTs as part of CS 14 and CS 15, while procuring future Manpack radios through a full and open competition (Radio Market Place). After selection of Rifleman radios, the Manpack RFP is expected in coming months (the draft RFP was published beginning 2015). A total of approximately 65,000 manpack radios are expected to be procured by the Army through 2032.

  - Mid-tier Networking Vehicular Radio (**MNVR**)
    The MNVR program procures radios that provide a new "mid-tier" in the tactical network, using NDI radios that run the **WNW** and **SRW** waveforms. By operating as "nodes" in a mobile, ad-hoc network, the radios provide voice, data and video from the upper tactical network at brigade and battalion to the lower tactical network at company and platoon echelons. Following full and open competition, the Army awarded a delivery order in 2013 to Harris for the initial set of MNVR radios[24]. The program is now in the formal developmental testing phase, with follow-on operational tests planned for Fiscal Year 2015. Fielding is expected in FY17.

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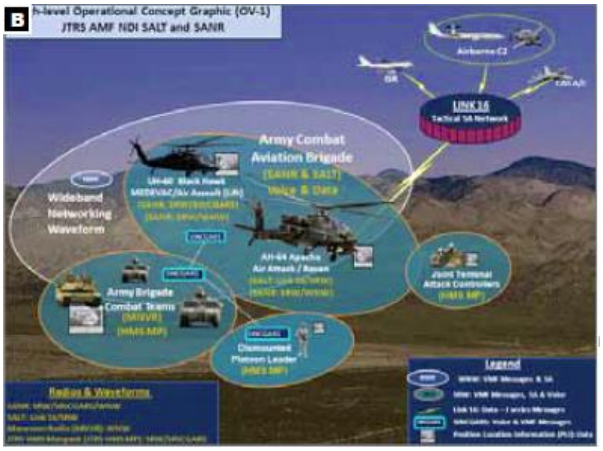
[21] 2014 Annual Report – PEO C3T – http:\\peoc3t.army.mil

[22] U.S. Army Releases Rifleman Radio RFP, Defense News 6th January 2015

[23] U.S. Army press release – 29th April 2015 - Army awards contracts for Rifleman Radio

[24] Harris PR – 25th September 2013 - U.S. Army Awards Harris Corporation Mid-Tier Networking Vehicular Radio Contract - The indefinite-delivery, indefinite-quantity contract has a potential total value of $140 million. Harris was chosen in a competitive procurement over three other bidders. The contract includes an initial order for up to 232 MNVR radio systems for the upcoming Network Integration Evaluation 15.1 in the fall of 2014.

- **SRW Appliqué**
  Four U.S. companies have been awarded a share in a five-year indefinite-delivery/indefinite-quantity (ID/IQ) contract by the U.S. Army Contracting Command to provide radio appliqués capable of running the Army Soldier Radio Waveform (SRW). The contract has a potential ceiling of USD988 million and also includes five one-year options that can be exercised at the army's discretion. The four companies are Exelis, GD, Harris, and Thales.[25] The SRW Appliqué aims to provide SRW Waveform capability to deployed SINCGARS legacy systems.



- **Standard Communications Modules for DoD Unmanned Systems**
  The U.S. DOD has issued in February 2015, an RFI on Standardized Communications Modules that can host one or more Software Waveform Modules to meet systems communications requirements for DoD unmanned systems with an open standard approach. The U.S. DOD has already fielded thousands of small Unmanned Aerial Vehicles (UAVs) and Unmanned Ground Vehicles (UGVs) over the last ten years. In consideration of rapid fielding, radios on these unmanned systems were accommodated with modified commercial-off-the-shelf items commonly available. Because of their proprietary nature, these deployments prevent interoperability across platforms.

- The **Aircraft Link**
  The marketplace business model is applied to airborne radios providing Air Ground interoperability capabilities and relying on SDR Waveforms: Small Airborne Link-16 Terminal (**SALT**) and Small Airborne Networking Radio (**SANR**). SALT and SANR are software- programmable radios running advanced networking SDR Waveforms. SALT uses the existing Link 16 waveform, in addition to the Soldier Radio Waveform (SRW), and is being procured for the Apache aircraft. The SANR uses three waveforms – the SRW, Wideband Networking Waveform (WNW) and the SINCGARS. The SANR is being developed for five aircraft types; both the SALT and SANR will be procured as NDI.
- Special Forces
  USSOCOM is to implement a COTS/NDI acquisition strategy for the STC **handheld two-channel radio**: the U.S. FY 2015 PBR PEDS show funding for 6,408 radios over the Future Years Defense Program (2014-19) at a unit cost of about USD14,000.[26][27] The specification features handheld with 2 channels and with multi-waveform capability. A similar approach is being launched for the Manpack, with the **Next Generation Manpack Radio (NGMP)** program with a first RFI published on 29th April 2015.[28]

3.5.5 Waveform Centric vision

The new business model deployed by U.S. procurement strategy, around the SDR radio market place, emphasizes the importance of the waveform that ensures the interoperability between the different radio procurements. The new networking waveforms, on top of existing waveforms such as SINCGARS, are providing enhanced networking capabilities to support the NCO transition.
The main waveforms are

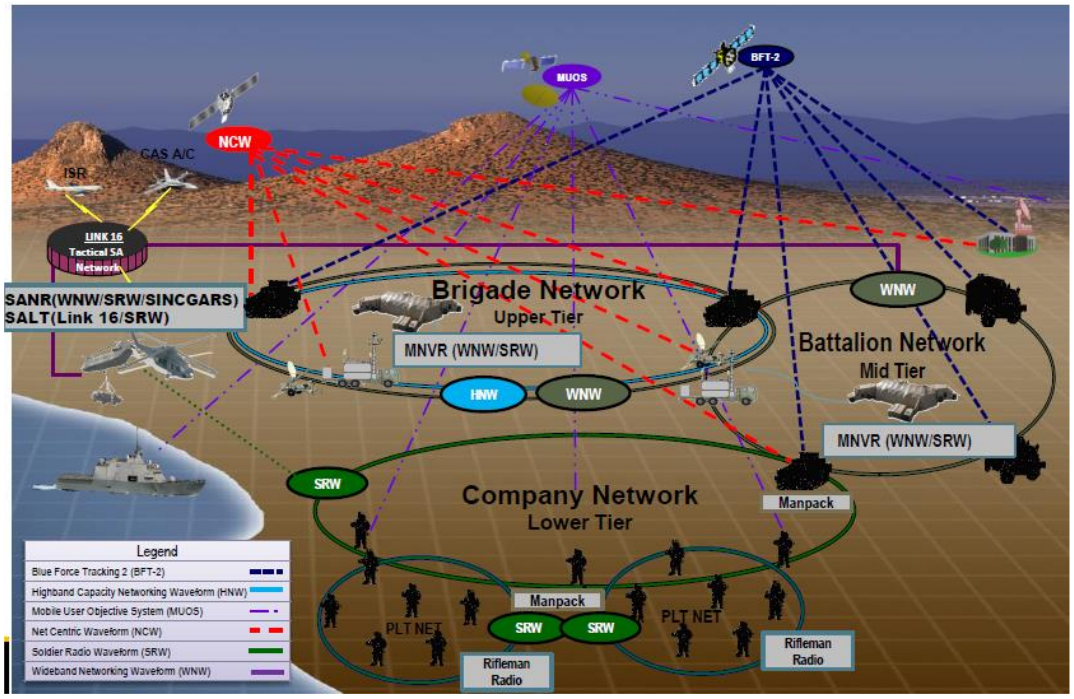
[25] Janes – 24th April 2014 - U.S. Army selects radio contract competitors

[26] Janes – 10th June 2014 - Sharing the dataload: squeezing more utility from SDR packages

[27] www.fbo.gov - Special Operations Forces (SOF) Tactical Communications (STC) Hand Held (HH) Radio - Solicitation Number: H92222-14-R-0017

[28] www.fbo.gov - RFI - SOF Tactical Communications (STC) Next Generation ManPack (NGMP) Radio - Solicitation Number: H92222-15-R-XXXX

- Soldier Radio Waveform (SRW),
- Wideband Networking Waveform (WNW), replacing ANW2 used in CS13/CS14 architectures
- Link 16, and
- MUOS, Satcom Waveform



U.S. Waveform Architecture

The importance of a waveform being supported by multiple waveforms is highlighted by SRW waveform, already ported into multiple waveforms[29].

SRW Ecosystem

- Ported into 13 different SDR Platforms
- Including 3 Airborne SDR Platforms

	US Market : SRW Ecosystem SRW WF Ported in SDR PTF	
	Supplier	*PTF*
Ground	Harris	117G,152A, 330E, MCMP
Ground	Thales	MBITR-2
Ground	Thales/GD	PRC-154
Airborne	RC	ARC210-G5
Airborne	Viasat/Harris	STT
Ground	Exelis	SR-R
Ground	RC/GD	PRC-155
Airborne	Raytheon	RT-1987

3.6 Conclusions

The various SDR program examples listed in this section illustrate a variety of approaches based on the different elements that could form the programs. These elements can include:

- Development of Waveforms and Platforms:
  - Answer the specific requirements from nations: platforms or waveforms, or
  - fund development efforts in areas where there are no off the shelf solutions.
- Porting Waveforms
  - The program could require porting of “legacy” waveforms, i.e. established waveforms that were running on other radios previously and that are still key elements of new generation radios and communications systems requirements, or
  - the program could develop new capabilities such as high data rate and MANET networking.
- SDR Architecture Improvements

[29] Status – WINNF – ITR-SIG November 2014

  - The program could include a variety of platforms that aim to support the same waveforms (to fulfil the interoperability capabilities): ESSOR, JTNC or COALWNW, or
  - the program could seek to have a cost efficient solution for porting the waveform onto multiple platforms. Some important efforts have been done in the area of SDR architecture: SCA improvements, various APIs, that could be open or that could be specific to the programs.
- Procurements of MOTS radio
  - Several international programs have procured MOTS radios to address their SDR requirements.

		Development Programs			**SDR Architecture**	**MOTS Radio**
		Waveform		Platform	Aspects	
Country	**Name**	Legacy	New			
Australia						X
Denmark						X
Europe	ESSOR		X		X	
France	Contact	X	X	X		
Germany	SVFuA	X		X	X	
International	COALWNW		X			
Italia	Forza NEC	X		X		
NATO	CTRN		X			
Norway	P8151					X
Poland	Guarana			X		
South-Korea	TICN	X	X	X		
Spain						X
Sweden	GTRS		X			X
UK	LE TacCis / Morpheus					X
USA	JTNC				X	
USA	PEO C3T / PM JTN	X	X			
USA	PTF Acquisition					X

Figure: SDR Programs Elements - Synthesis

3.7 SDR is more than reality

A few figures show the reality of the SDR transition and the start of global adoption of new SDR technologies, including the SCA standard.

The WINNF Working Group has identified

- near 40 Waveforms developed and ported in U.S. and International Markets
  - More than 50 percent are waveforms that are actively developed or deployed into forces
- more than 40 Platforms identified in U.S. and International markets
  - 15 international vendors proposing , developing and deploying SDR platforms inc. SCA capabilities to support multi-waveforms

Waveforms cover both categories, new wideband networking waveforms, and porting of existing waveforms including possible evolution path toward narrow band networking capabilities.

See Annex 9 SDR Market Inventory for details of the study.

4 Toward New Business Models

4.1 Introduction

The previous 2013 report listed the different business model types, different roles and the challenges for such programs going from “off the shelf radios” to full national programs (as called POR[30] in US).

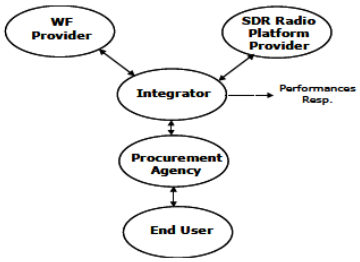


Figure 22: Typical SDR Program Stakeholders

The different roles (WF provider, PTF provider, integrator, procurement agency and end user) and their interaction is depicted in the Figure 22 of the 2013 report, as shown at right.

The following use cases have been introduced:

- Full MOTS solutions: supply of radios, with fully integrated Waveforms and no willingness to separate supply of Waveforms and radio platforms.
- Delivery of Platform and Waveform(s) by the same radio supplier; in this case, the SDR concept of decoupling WFs and PTFs roadmap is used, but is managed by the same supplier. In this case, the WF portability is limited to single vendor environment. (These two first cases are therefore without an Integrator role, as there are no multiple vendors involved in use cases.)
- National Programs: more complex programs split deliveries or developments between WF and SDR radio platforms. The word “National” is used because it is driven by sovereignty capabilities (capability to manage the diversity of the suppliers, including origins of suppliers and/or willingness to be independent, i.e. no single vendor dependency, from suppliers).
  Different program categories can be identified.
  - WF: development of waveforms only; could be for national usage only or for coalition interest (regional/group of nations). The waveform will have to be integrated onto platforms selected by the procurement agency but under different acquisition programs.
  - WF and PTF: In addition to WF, some specific requirements for local PTF parts could occur. For instance specific requirements in terms of Information Assurance could drive some specific requirements for the platform acquisition.
  - Full specifications case; the procurement agency issues detailed specifications of all parts.

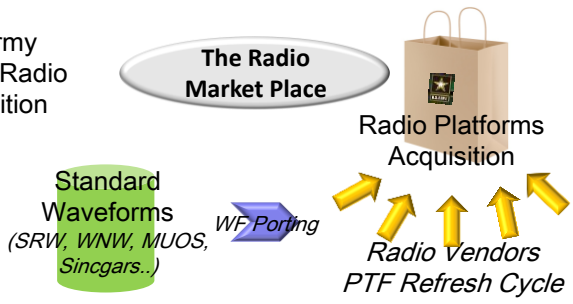
This use case is also characterized by the “multi” origins approach with possible multi-supplier involvement, together with an integration role that is clearly identified and by a strong program management to drive full specifications program cases.

4.2 U.S. Business Model Update

Since the last report, the U.S. business model has evolved toward an SDR marketplace concept. In the last report, the end of the JTRS platforms program was reported and a transition toward an NDI approach for the platforms highlighted:

- JTRS to JTNC transition with a focus on waveforms
- Introduction of the NIE and agile acquisition approach.

US Army Tactical Radio Acquisition



4.2.1 SDR Marketplace

PEO C3T has launched the idea of the Radio Market Concept in 2014[31]. This concept is based on a competitive acquisition of SDR

[30] POR: Program Of Record

[31] PEO C3T MG D.Hugues interview to C4ISRNet 30th September 2014

Platforms, MOTS, running standard waveforms that are provided by DOD (and ported by SDR Platforms vendors).

This concept permits benefit from regular platform enhancements thanks to the refresh cycle.

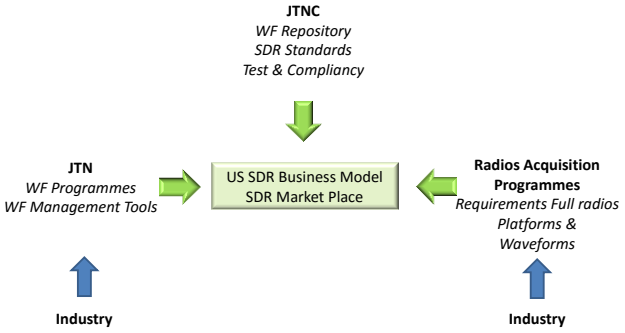
PEO C3T MG D.Hugues C4ISRNET 30th Sept 2014

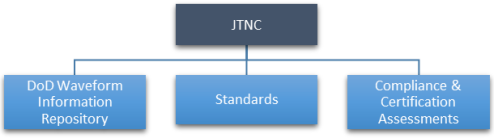
*On the other hand, the processing power inside each one of these sets increases based on the rate of **Moore's Law**. This is why the **radio marketplace concept** is so important(…) That is why competitive buys on delivery orders, and having a strategy to refresh these in a certain amount of years is critical. (…)What is the **refresh cycle**? (…)What I am hoping for is that through competition we drive the cost of the material down so that refresh in **five to seven years** on each one of these sets is a viable option for the military.*

4.2.2 Roles

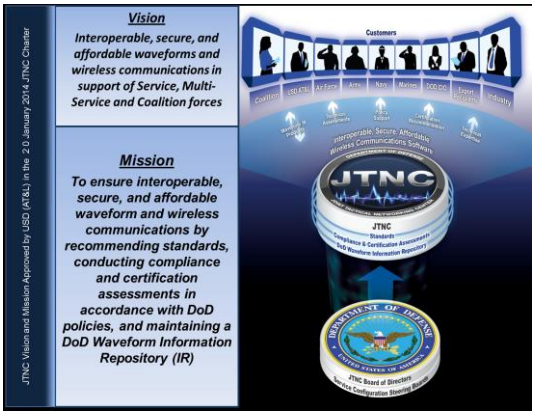
The business model permits distinguishing different roles given to different DOD departments:

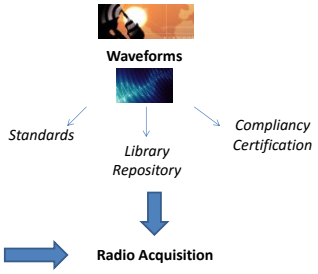
- SDR Platforms acquisitions
- Waveform acquisitions and roadmap: managed for SRW, WNW, MUOS (tactical ground domain) by PEO C3T – JTN[32]. Other waveforms like Link 16 are managed by U.S. Navy SPAWAR in MIDS program
- Standard, compliancy and certification by JTNC[33]





The JTNC role has focussed on enabling waveform interoperability and therefore portability, through standards. The three main activities are depicted in the accompanying chart. The SCA Standard was mandated in JTNC's main last tactical radio procurement as reported in chapter 6.2.

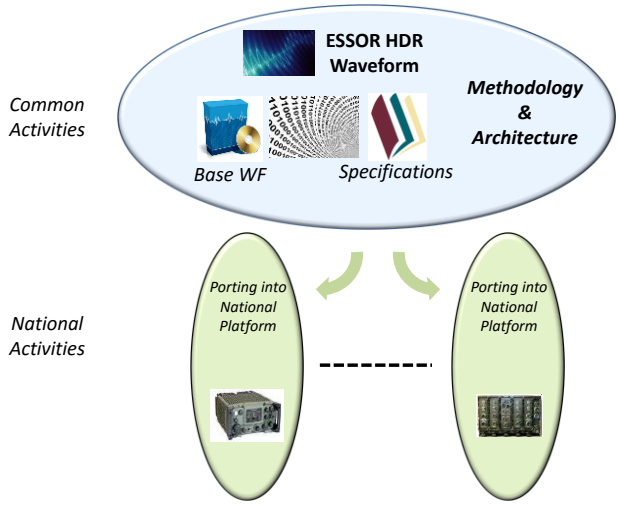




[32] JTN: Joint Tactical Network - http://peoc3t.army.mil/jtn/

[33] JTNC: http://jtnc.mil/Pages/AboutJTNC.aspx

4.3 ESSOR Business Model



The ESSOR business model is also, and by nature, a waveform centric business model. The core of the program was to define and develop new ad-hoc networking in such a way to ease the porting into multiple origin platforms (different suppliers, different national origins i.e. different national security).

An architecture, based on SCA 2.2.2, and a waveform development methodology have been developed to ease the portability of the waveform[34].

In this approach, the development of the waveform is uncorrelated from the acquisition of the SDR platform that is under the responsibility of each nation.

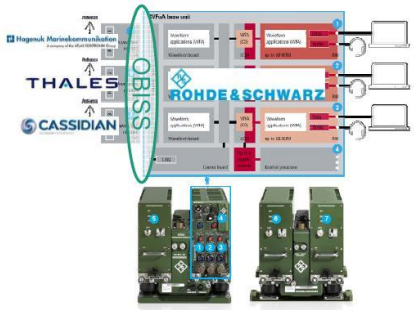
4.4 System Integration Versus WF Centric

4.4.1 German SVFuA Program Example

The German SDR Program, SVFuA[35], features a specific approach. It is based on contributions of multiple vendors, providing modules and integrated in order to provide SVFuA radio to end users. This approach, with competition benefits between the different modules vendors, is possible through an available WF development and porting process, and standardized interfaces between different modules. This approach is possible because of a strong integration role is ensured to deliver the radios (platform and waveforms ported into platform) to end users with expected performances met.

Roles are split between:

- Platform
  - Modules
    - Base Device
    - Security
    - Radio/Transceiver Modules (3 mains: HF, V/UHF and Wideband)
  - Integration
- Waveforms
- System Integration



The overall project structure is shown in the figure at right.

In order to achieve the modules approach for the platform, usage of standardized interfaces has been made, like OBISS (Open Baseband Interface Specification for SDR).

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[34] Previous report – chapter 5.5.2. ESSOR Base WF methodology for Portability

[35] Refer to "SVFuA The German SDR Program" and to "Current status of SVFuA and way ahead from an industry perspective" presentations provided at 4th Annual Tactical Radio Workshop at WInnComm-Europe 2014, Wireless Innovation Forum

4.4.2 Business Model

Differences between U.S. business model, waveform centric, and German business model, relying on system integration approaches, have been highlighted in different presentations and contributions.[36] Both are summarized in the figures below.

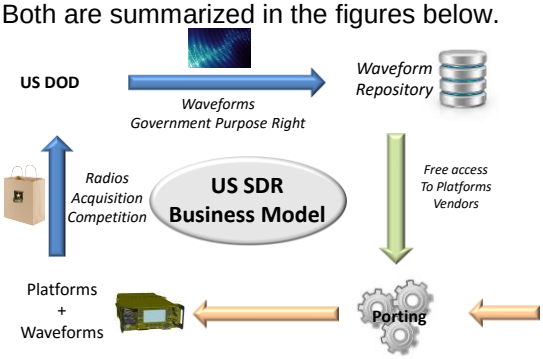


Fig. WF Centric Business Model

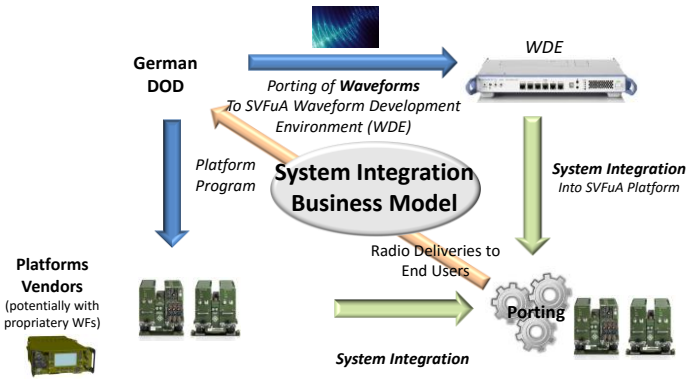


Fig. System Integration Business Model

4.5 Multi-Waveform, Multi-Platform and Multi-Suppliers

The following table gives a synthesis of different programs according to their scope:

- Does it concern multiple Waveforms?
- Does it include multiple Platforms?
- Are multiple suppliers involved?

National programs can cover one, two or all three categories, according to local context and program requirements. The multi-suppliers category opens the business model to various models including partnerships, alliances or integrators as shown below:

	Multi WF	Multi PTF	Multi Suppliers
US Army Acquisition	X	X	X
L16		X	X
France Contact	X	X	
Germany SVFuA	X		X
ESSOR		X	X
Italy	X	X	
National Program Business Model			

Multi Suppliers = Partnerships & Alliances, Integrator Role

[36] "About Business Models for future SDRs: Use Cases to tackle future Waveform Portability Issues during Procurement" S. Singh et al, in Proc. of Military Communications and Information Systems Conference (MCC), Saint-Malo, France, October 7th – 8th, 2013

4.6 Challenges and Opportunities of new SDR Business Models

Introduction of SDR generation into defense tactical markets opens new areas and market perspectives.

- As usual in radio technologies (and it is applicable for commercial and for defense sectors), introduction of a new generation requires important investment. Usually for each generation, it is a higher investment. Therefore, the introduction of a new generation can force the industry to adapt itself: reduction of players, mergers, partnerships and alliances.
- Such technology can also permit new actors to come into the market: waveform solutions, SDR ecosystem, local actors in national programs, etc.

These new business models answer to market trend challenges, such as

- uncertain budgets requiring partnerships or alliances to propose solutions answering customer requirements, and
- emerging countries with willingness for their local and national industry to have a more important role in the value chain.

The market as reported in this document shows concrete examples of such evolution:

- introduction of the SDR ecosystem (See chapter 7)
- Partnerships, alliances, and consortia in the area of SDR: ESSOR Program in Europe, SVFuA program in Germany, partnership FlexNet between Thales and Rockwell-Collins, partnership between Viasat and Harris for airborne radios, Link-16 programs, etc.

New C4I systems and net centric visions require seeing the tactical communications capabilities on the battlefield as a system with more and more end-to-end capabilities rather than a collection of individual radio capabilities (as in the previous generation with the rule, 1 radio = 1 waveform). This system approach, with multiple elements with different life cycles, implies de-facto a new complexity (communications architecture role) to be managed.

4.6.1 Benefits versus challenges

Benefits of such programs are multiple:

- new generation radio with capabilities to introduce new services for end users,
- increased sustainability (SW upgrade, backwards compatibility) results in gain in the life cycle cost of radios,
- possible competition between suppliers results in procurement flexibility in terms of pricing,
- possible multiple sources leads to better future proof-ness and second source procurement security,
- possible partnerships and alliances yield flexibility for national industry regulators to manage national competences and thus preserve sovereignty in chosen critical industries

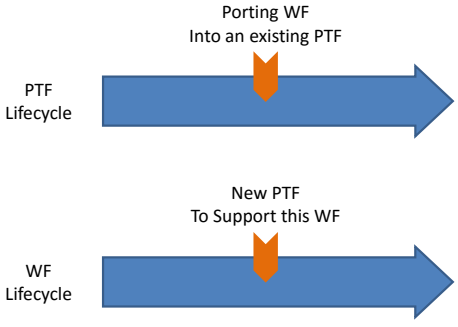
But, these programs will have to manage the challenges, already listed

- Different business models resulting in different procurement and responsibilities that need to be adapted,
- integration role to be managed (and especially the responsibilities),
- life cycle WF and life cycle PTF requiring management of the roadmap (See §2.5.3 and following 4.6.2), and
- managing different actors.

4.6.2 Development Cycle: Waveform and Platform independent development cycles

Two use cases can be identified in SDR Programs:

- introduction of a new waveform into and existing platforms which introduces WF portability challenges (see §2.5.1 and following), and
- development of a new platform and porting an existing WF onto this platform resulting in WF portability challenges, but having the flexibility to adapt the PTF specification to ease or to simplify the porting.



These use cases have been highlighted in the presentation and report from Fraunhofer.[37]

4.6.3 WF porting challenges

§2.5.1 introduces the compatibility check between WF and PTF with multiple factors. The PTF supports the performance requirements from the WF, in terms of architecture, in terms of processing capabilities requirements and in terms of radio performances requirements. The Porting cost is linked to all factors, not only to standards (SDR architecture standards but also methodology and porting rules) that in general optimize porting, optimizing cost and therefore making, business wise, achievable porting into multiple Waveforms.

[37] "About Business Models for future SDRs: Use cases to tackle future Waveform Portability Issues during Procurement", S. Singh et al, in Proc. Of Military Communications and Information Systems Conference (MCC), Saint-Malo, France, October 7th-8th, 2013

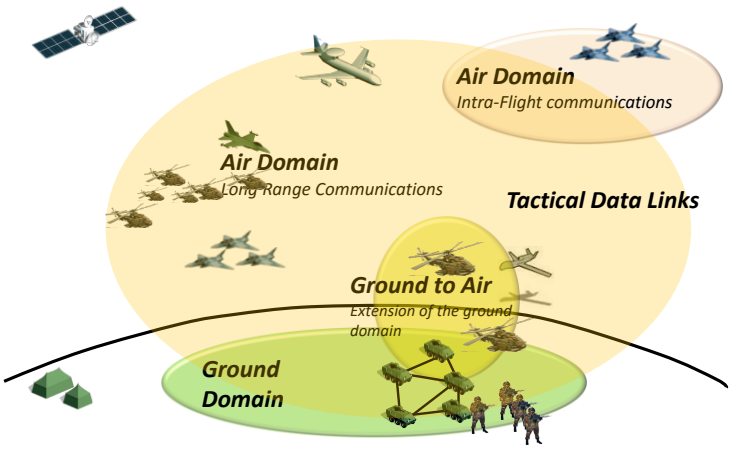
5 Examples and Experiences

5.1 Interoperable Waveforms in Airborne Domains

5.1.1 Overview

Interoperability with SDR is not a concern for Land Forces only. Even so, the airborne domain is usually ahead to ensure and provide interoperability solutions:

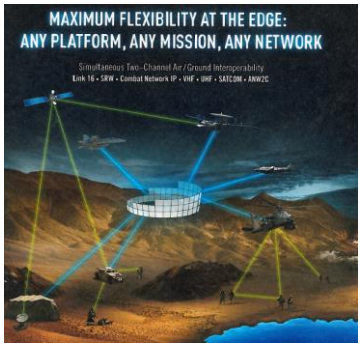
- Joint and coalition interoperability is a must, as shown in recent operations (Middle-East, Africa recent operations)
- Different platforms (nationality, types, arms origin – i.e. Army, Air Force, etc.) are involved in the operations theater
- Interactions with Ground & Land forces are now usual way to conduct operations.



Airborne communications systems include different capabilities, such as:

- different waveforms according to different applications
  - long range
  - intra flight
  - ground to air
- tactical data links exchanging RT situation awareness information in the battlefield, command centers and weapon systems.

The following examples can be used to illustrate that SDR is a reality in Airborne domain:



- Link 16 Waveform

Through a successful business model, the MIDS program has developed a TDL waveform available across different platforms involved in the battlefield, ground, airborne, naval and weapon systems.

- Interoperability between land domain and air domain

Other examples of waveforms that are ported in ground and airborne platforms to support air-ground coordination:

  - Havequick Waveform is an example of a successful model of waveform portability among different platforms (ground and airborne), and used for CAS (Close Air Support) application, and
  - waveforms developed for ground application are ported into airborne platforms for ground to air interoperability, sharing the common operation picture and providing advanced C2 capabilities for coordinated actions. From narrowband to wideband which hs already been seen with narrow band waveforms like Fastnet or Sincgars, it is now extended to wideband networking waveforms (example SRW, or ESSOR HDR). For SRW Waveform in U.S. market, already three airborne SDR platforms support the waveform (over a total 13).

Example of SDR Platforms in Airborne Domain

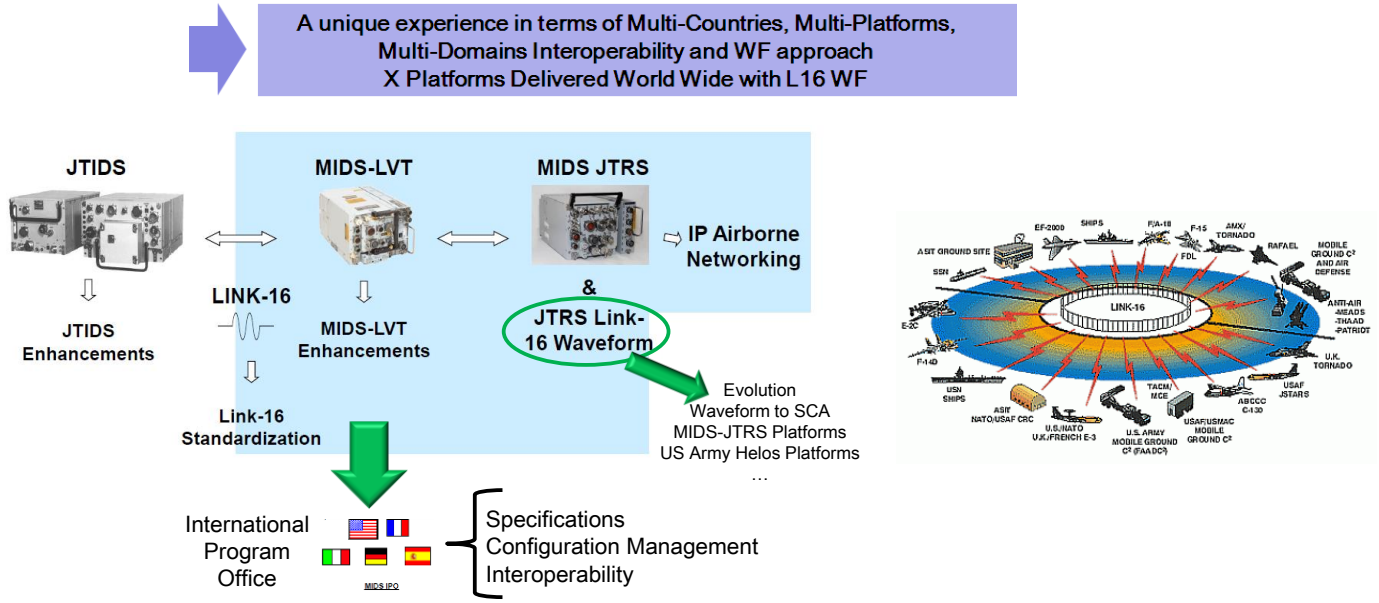
Therefore in the airborne domain, and even before the land domain, the multi-waveform, multi-platform and multi-supplier requirement is a reality by nature.

5.1.2 Tactical Datalink and L16 Waveform

Link 16 is a multinational system for transmitting broadband, jam-resistant, secure data and voice across a variety of air, sea, and ground based platforms. Link-16 has evolved across different programs (U.S. & Multi-national).

The Link 16 case provides interesting perspective for SDR business models, as the Link 16 Waveform is:

- an interoperability waveform,
- ported into multiple platforms from different suppliers,
- a waveform with a roadmap (several releases to be introduced through SW and managing compatibilities between releases),
- evolving toward SCA, and porting the waveform into new platforms (non Tactical Data Link Platform), and
- includes international cooperation.



Link 16 Programs: Data Link Platforms and L16 Waveform

5.2 Waveform Provider: A Possible Business Model?

SDR technology provides the capability to distinguish providers for platform and providers for Waveform. Several times the possibility to have a pure waveform provider business model has been raised in the SDR community. Besides the waveforms development programs (funded or led by various government or international agencies/organisations, such as ESSOR HDR, COALWNW, NATO , U.S. JTN, etc.), or waveform technologies subcontractors to radio providers, is there an existing example of a company focusing on providing waveforms to several third parties, i.e. platform providers or local integration parties through an adequate business model (licensing and fees)?

A few years ago, Etherstack[38] had been successful in providing P25 technologies to radio platform providers in U.S. market. More recently Gatehouse[39] has been proposing Satcom BGAN Waveform capabilities to radio platform providers. In both cases, companies are not radio providers but companies working within the SDR ecosystem providing technologies to radio providers. (See chapter §7 SDR Ecosystem).

[38] Etherstack: www.etherstack.com

[39] Gatehouse: www.gatehouse.dk

Because of the size of the market (the radio tactical market is not commercial wireless market), its characteristics, such national sovereignty and still limited standardized waveforms used by military domains, the reality of such a business model can be questioned. Gatehouse gave an interesting testimonial of their experience during WINNF conferences[40]. See Annex chapter for complete details.

Gatehouse concludes that “for some time there will be a preference from hardware/radio manufacturers to promote proprietary waveforms leaving very little room for independent waveform providers. There is a need that end-users require radio manufacturers to develop multi-waveform products or alternatively separate the procurement of radios and waveforms, thereby creating an independent global market for waveforms.”

[40] WinnComm SDR 2015 Conference – Schaumburg March 2014

6 SCA 4.1 Introduction: Toward A New Horizon for the SDR Market

6.1 SCA 4.1 to Enhance Waveform Interoperability and Affordability

After the successful introduction of SCA 2.2.2, largely deployed and used in U.S. and International markets, the latest revision to the SCA[41] [42] incorporates recent technology advances in an effort to enhance waveform interoperability, waveform portability, security and affordability.

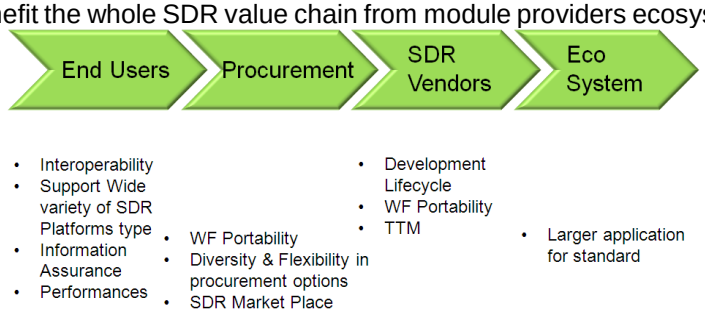
The new SCA 4.1 capabilities were introduced in a manner which supports the ability of SCA 2.2.2 applications to be run on SCA 4.1 platforms, allowing platform developers to take advantage of the technical improvements and flexibility of SCA 4.1 while preserving the investments in SCA 2.2.2 applications.

SCA 4.1 features multiple advantages[43] providing real benefits to the warfighter, radio vendors and the complete SDR ecosystem.

Advantages of SCA 4.1 include:

- support of a wide variety of SDR platform types
  - better applicability for dismounted and lower cost platforms including longer battery life
  - improved architectural scalability to address the size, weight, power and cost requirements
  - improved support for devices such as DSPs and FPGAs
- enhanced information assurance
- performance improvements
  - start up time enhancements with boot and WF deployment
  - improved real-time performance
- reduced development lifecycle costs
  - testing cost enhancements
  - requirements cleanup
- WF portability enhancements
- easy introduction with backwards compatibility features including protection of the SCA 2.2.2 waveform application investment

All these features benefit the whole SDR value chain from module providers ecosystem to the end users.



[41] JTNC Releases SCA 4.1 Draft February 04, 2015: http://jtnc.mil/Press%20Releases/JTNC_FY15_NR_001_JTNC%20Releases%20SCA%204%201%20Draft_FINAL.pdf

[42] WINNF Press Release: Joint Tactical Networking Center Publishes Software Communications Architecture (SCA) 4.1 Draft, February 10, 2015: http://groups.winnforum.org/sca-press-room

[43] WINNF – JTNC SC4.1 Webinar February 18, 2015, SCA 4.1 Benefits Overview: http://www.wirelessinnovation.org/sca-41-webinar

SCA 4.1's promising future: the benefits are recognized by multiple industries and national stakeholders as highlighted during the SCA 4.1 preview event organized by the Forum in October 2014 in Aberdeen (MD).

***Aeroflex** : SCA 4.1 –it's not just for tactical radio...*

***DGA** is investigating the potential for SCA4.1 for its French SDR roadmap*

***ESSOR** Community congratulates the joint multinational efforts performed in the framework of the WINNF SCA 4.1 WGs, integrating positively significant contributions provided by ESSOR.*

***Fraunhoffer** : The new SCA 4.1 provides a crucial edge over SCA 2.2.2*

***Harris** : SCA 4.1 will be a useable specification*
SCA 4.1 is essential for a broad commercial adoption

***NordiaSoft** already has implemented many features that are now present in SCA 4.1*

***PrismTech** anticipates that SCA 4.1 enhancements will help to accelerate the adoption of SCA going forward,*

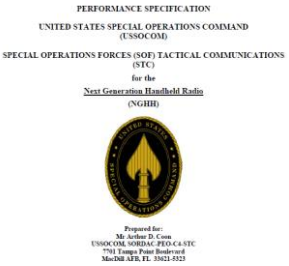
***Reservoir Labs** anticipates continuing to support the evolution of the SCA with an upgrade of R-Check SCA for SCA 4.1 in 2015*

***Selex ES :** includes essential features which maximize investments , allowing for a smooth transition toward the next SCA implementations and for a wider spread on commercial products*

***Thales** is highly interested by SCA 4.1, and has actively contributed to its development ; Thales is positive regarding adoption of SCA 4.1 Core Spec"*

6.2 SCA is mandated in U.S. acquisitions

The recently published Request for Proposals or Information from the U.S. DoD for Tactical Radios, since mid-2014, include requirements on SCA support:


PERFORMANCE SPECIFICATION
UNITED STATES SPECIAL OPERATIONS COMMAND
(USSOCOM)
SPECIAL OPERATIONS FORCES (SOF) TACTICAL COMMUNICATIONS
(STC)
for the
Next Generation Handheld Radio
(NGHH)

- Solicitation on Rifleman Radio published January 2015[44]
- Special Operations Forces tactical communications for the Next Generation Handheld Radio solicitation, Nov 2014 [45]
- Special Operations Forces tactical communications for the Next Generation Manpack Radio solicitation, RFI April 2015[46]
- RFI on Standard Communications Modules for DoD Unmanned Systems[47], February 2015
- Procurement for Manpack Radio, draft RFP issued March 2015[48]

6.3 History of the SCA

The original technologies for SCA specifications were developed in the late 1980's and early 1990's with the first public release of a consolidated specification occurring through the Forum's Technical Report in 1997 as the "Software Radio Architecture (SRA)"[49]. The SRA architecture further matured and has been a key contribution to the SCA specification efforts in the JTRS program.

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[44] Defense News: U.S. Army Releases Rifleman Radio RFP - January 6, 2015

[45] www.fbo.gov - Special Operations Forces (SOF) Tactical Communications (STC) Hand Held (HH) Radio - Solicitation Number: H92222-14-R-0017

[46] www.fbo.gov - RFI - SOF Tactical Communications (STC) Next Generation ManPack (NGMP) Radio - Solicitation Number: H92222-15-R-XXXX

[47] RFI published 11th February 2015: https://www.fbo.gov/index?s=opportunity&mode=form&id=aa9a1ed97dae39d05f55ccebc241c7df&tab=core&_cview=1

[48] Draft RFP published 29th March 2015: https://www.fbo.gov

[49] History of the Forum and the SCA - http://groups.winnforum.org/SCA-History

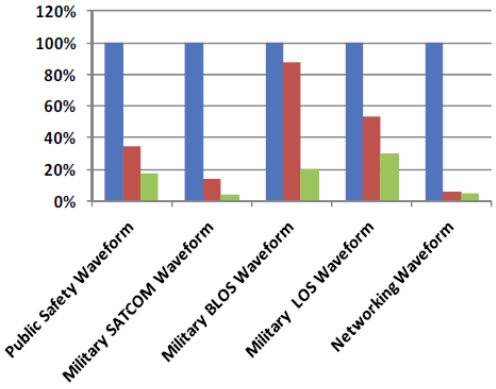
The SCA 2.2.2 largely deployed and used today was released in 2006 after releases of SCA introduced from 2000 onward.

The SCA 4.1, with final release expected mid-2015, is anticipated to be the second major release of SCA to be used and deployed.

6.4 Standard eases WF portability: SCA Benefits, and Industry feedback

Harris has provided some experience feedback on WF portability in past SDR conferences, mainly:

- SDR12-WinnComm - Jan 2013
- WF Portability Workshop – Jan 2014



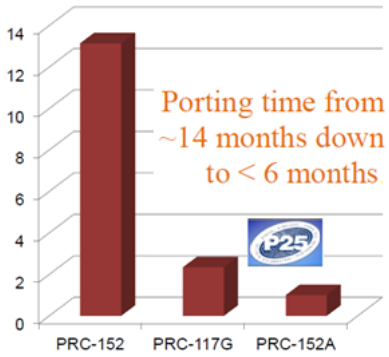
The main feedback is related to efficiency gains when porting WF into multiple platforms (Original effort for Ptf1, gains for Ptf2 and Ptf3) and showing through efficiency gains that porting is facilitated by basic principles of the SCA.

This experience and report is related to a **single vendor** environment, i.e. development and porting of waveforms into multiple platforms from a single radio vendor. (See Business Case sections.)

In SDR12-WinnComm, Harris has provided the relative cost of porting of different platforms onto different platforms.

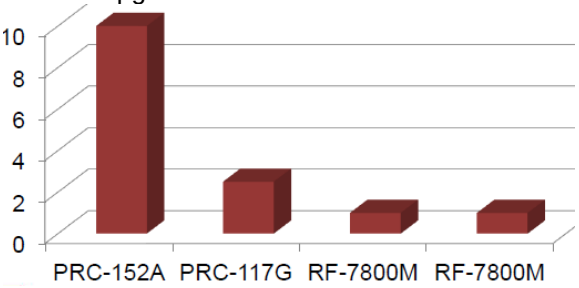
In the WF Portability Workshop, Harris reported two experiences, on P25 and on OE upgrade toward 2.2.2.

- P25 Waveform porting



- Key Aspects:
  - *"Third party"* commercial waveform application ported to AN/PRC-152 HH
  - AN/PRC-117G MP and AN/PRC-152A done at same time but with the 117G in the lead
  - Highly collaborative approach between waveform provider and radio platform/SCA experts on original development
- Observations:
  - Commercial waveform porting required much more modification than application of software "wrappers".
    - Functional allocation to HW and SW processing frameworks.
    - SW threading model and real-time analysis.
    - Compliance with SCA architecture and APIs presented by OE.
- Time and Cost implications:
  - Porting time from ~14 months down to < 6 months.

- OE Upgrade to SCA 2.2.2



- SCA 2.2.2 originally implemented in the AN/PRC-152A
- Subsequently ported to the AN/PRC-117G
  - Costs for 152A and 117G are labor only (no certification fees) but do include preparation and on-site support at the JTeL
- Effort for RF-7800M-MP and RF-7800M-HH little more than build and verify
  - Due to highly similar Digital and SW Component architecture cost was 10% of original effort

Both reports show:

- benefits from using SCA standard SDR architecture, and
- importance of the platform architecture among the cost factors.

6.5 SCA Standard usage in areas other than tactical communications

SCA Standard and associated APIs are used beyond the mobile tactical communications market, such as secured communications for the tactical edge battlefield. Below are few examples of applications:

- Deployable communications: LOS Microwave radio
- Satcom systems
- Electronic warfare

It also completes applications of the tactical edge

- Ground Tactical Communications
- Airborne Tactical Communications
- Naval Tactical Communications

Such a large usage of the standard shows its benefit in multiple waveform applications, as well as industry, in addition to end user benefits from using recognized standards.

7 SDR Ecosystem

7.1 Overview and Benefits

Together with the U.S. and Europe SDR programs, an SDR ecosystem has been developed, with various suppliers who are able to provide:

- HW Modules: especially for fast prototyping steps in order to reduce and optimize the complete development life cycle to ensure an efficient go to market,
- OE SW elements: various providers are able to provide OE SW elements, such as CF, ORB, or OS SW
- SDR labs: suite of tools is available in order to specify, to develop or to port waveforms according to international SDR standards.

This ecosystem, enabled through the usage of an open standard, such as SCA and associated APIs, is very beneficial for the development of SDR radios and offers the following benefits to end users:

- usage enabled by such an ecosystem
- time to market
- development cost decrease
- ease in cooperation schemes (industry, nations, etc...)
  - sharing tools
  - common language usage and open interfaces
- ease in sub-contracting from main radio suppliers toward emerging sub-contracting industry

7.2 Wide Range of Suppliers

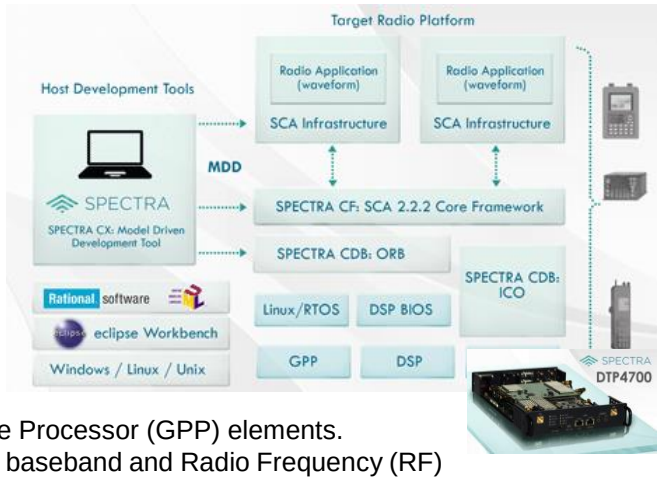
The SDR Ecosystem is made by multiple companies providing various solutions and services in the following fields:

- modules and fast prototyping: hardware modules & OE SW modules
- waveform solutions
- development and integrated labs
- test and verifications
- services (training, consultancy, etc.)

Two suppliers are providing integrated capabilities to enable newcomers to move into the new SDR value chain.

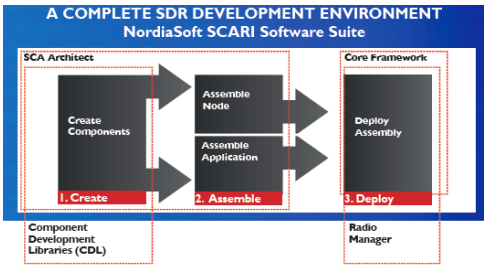
Prismtech proposes Spectra, a complete SDR SCA product suite for radio system developers and integrators providing commercial-off-the-shelf (COTS) development tools, software infrastructure and development and test platforms. Spectra includes:

- Spectra CX: model-driven development tool easing the SDR/SCA development process.
- Spectra CF: COTS SCA Core Framework.
- Spectra CDB: SDR middleware stack running across a wide range of Field Programmable Gate Array (FPGA), Digital Signal Processor (DSP) and General Purpose Processor (GPP) elements.
- Spectra DTP: a wideband, high performance, baseband and Radio Frequency (RF) SDR Development and Test platform



The **NordiaSoft** SCARI Software Suite is an Integrated Development Environment (IDE) for SCA-based SDR development, used by platform and radio manufacturers, as well as application/waveform providers. The suite includes:

- NordiaSoft SCARI Core Framework
- NordiaSoft SCA Architect which covers the complete SDR development life cycle, from the creation and validation of components to their assembly into applications or nodes
- NordiaSoft Radio Manager monitoring tool essential tool for debugging and testing



7.3 Wireless Innovation Forum Conferences and Exhibitions: an Open Place for the SDR Ecosystem

Wireless Innovation Forum conferences in the U.S. and Europe give the unique opportunity to access different providers and provide building blocks to help speed up the development of SDR programs.

8 Conclusions

Various Business Models are applied for SDR programs depending on the local context (local industry skills and priorities, a nation's sovereignty objectives, and interoperability at national and international levels requirements). SDR technology is now reality and used to deploy new capabilities into forces. SCA 4.1 standard's introduction will bring a lot of additional capabilities that will drive the majority cycle of the standard adoption for the tactical communications and other related defense communications applications.

Waveforms are the cornerstone of the different SDR business models creating a waveform centric approach of the business models.

Introduction of new features in waveforms, through SDR technologies, will increase performance of deployed systems and therefore provide benefits for warfighters.

Already various areas of improvements are identified:

- Networking: expected multiplications of nodes (for instance unmanned systems), require long term roadmap evolutions in networking waveforms, and
- Spectrum aspects
    - spectrum efficiency improvement to cope with increased capacity requirements,
    - dynamic spectrum management: increased pressure on military spectrum by commercial usage, deployment of networking systems in coalition environment, and
    - introduction of new capability in radio platforms benefiting from sensing capabilities of these platforms.

Developing waveform Roadmaps will pave the future of the SDR radio platforms.

SDR Technology is maybe mature, but to reach the majority phase of the technology adoption cycle an evolution roadmap needs to be developed. Wireless Innovation Forum conferences, workshops, and working groups from its Coordinating Committee on International SDR SCA Standard, and Spectrum Sharing Committee contribute to building this vision.

9 Annex - SDR Market Inventory

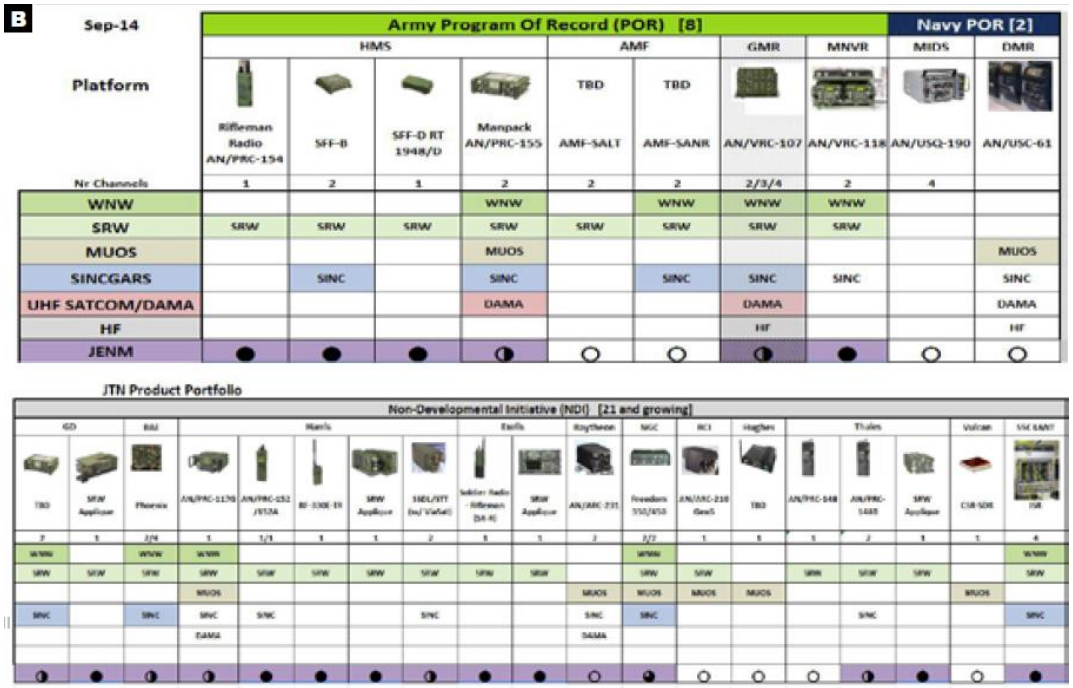
9.1 Waveform Inventory

US Origin			Outside US	Supplier or Prog	
JTNC	Other				
COBRA	ANW2		PR4G-Fastnet	Thales	
EPLRS	SATURN		Easy II	Selex	
HAVEQUICK II	QL		SEM	SVFuA	
HF	P25		FlexNet	Thales/RC	
JTRS Bowman	Talon		SBW	Selex	
Link 16			ESSOR HDR	ESSOR	
MUOS			MARS	SVFuA	
SINCGARS			R&S WB	R&S	
SRW			R&S NB	R&S	
WNW			Elbit	Elbit	
VULOS			BNET	Rafael	
UHF Satcom			France Contact	Contact	
TTNT			Korea TMMR	TMMR	
ATC			India Legacy	India SDR	
MNW					
CIB					
DDL					
MR-TCDL					
Total				**37**	
Total (Active, known, deployed..)(green)				**20**	54%

9.2 Platform Inventory

	Supplier	Nb Configurations	Comments
International Market	15 vendors	**23**	
Tactical Wireless IP Network	EB	1	
Falcon III	Harris	4	7800M-MP, 7800M-HH, 7800V, 7850
RT-8400	Rockwell Collins	1	
FlexNet family	Thales/Rockwell-Collins	2	
SDTR	R&S	1	
Swave	Selex	2	
Fastnet	Thales	1	
Nextwave	Thales	1	
R3500	Radmor	1	
EHCLOS	Ultra	1	
SDR7200	Elbit	2	
TBC	IAI/Elta	1	
TBC	BEL	1	
Bnet	Rafael	1	
TBC	HAL	1	
TBC	LIG NexOne	1	
TBC	Samsung Thales	1	
US Market		**20**	
See JTNC Table (Newsletter 1)		18 radios	
Additional / JTNC Table		4	
MBITR2	Thales		
PRC148	Thales		
MPMC	Harris		
RF330E	Harris		
Estimated Not relevant radios in JTNC Table		-2	
MNVR			
Future			
TOTAL		20	

JTN Portfolio Table – PEO C3T – 2014 Portfolio Document[50]



B	Sep-14	Army Program Of Record (POR) [8]								Navy POR [2]	
		HMS				AMF		GMR	MNVR	MIDS	DMR
	Platform	Rifleman Radio AN/PRC-154	SFF-B	SFF-D RT 1948/D	Manpack AN/PRC-155	TBD AMF-SALT	TBD AMF-SANR	AN/VRC-107	AN/VRC-118	AN/USQ-190	AN/USC-61
	Nr Channels	1	2	1	2	2	2	2/3/4	2	4	
	WNW				WNW		WNW	WNW	WNW		
	SRW	SRW	SRW	SRW	SRW	SRW	SRW	SRW	SRW		
	MUOS				MUOS						MUOS
	SINCGARS		SINC		SINC		SINC	SINC	SINC		SINC
	UHF SATCOM/DAMA				DAMA			DAMA			DAMA
	HF							HF			HF
	JENM	●	●	●	◑	○	○	◑	●	○	○

JTN Product Portfolio

Non-Developmental Initiative (NDI) [21 and growing]																			
GD		BAE	Harris					Exelis		Raytheon	NGC	RCI	Hughes	Thales			Vulcan	SSC SANT	
TBD	MW Applique	Phoenix	AN/PRC-117G	AN/PRC-152 /152A	RF-330E-TI	MW Applique	SDL/STT (w/ ViaSat)	Soldier Radio - Rifleman (SA-R)	MW Applique	AN/ARC-231	Freedom 550/450	AN/ARC-210 Gen5	TBD	AN/PRC-148	AN/PRC-148B	MW Applique	CSR SDR	ISR	
2	1	2/4	1	1/3	1	1	2	1	1	2	2/7	1	1	1	2	1	1	4	
WNW		WNW	WNW								WNW							WNW	
SRW	SRW	SRW	SRW	SRW	SRW	SRW	SRW	SRW	SRW		SRW	SRW		SRW	SRW	SRW		SRW	
			MUOS							MUOS	MUOS	MUOS	MUOS				MUOS		
SINC		SINC	SINC	SINC			SINC			SINC	SINC				SINC			SINC	
			DAMA							DAMA									
◑	●	◑	◑	●	●	●	◑	●	●	○	◕	○	○	○	◑	●	○	●	

9.3 U.S. Radios Land Forces Deployment Status – Second Generation

Second Generation: Networking capable radios: Total around ~80 000

- Harris – PRC117G and PRC152A radios: total ~55 000 December 2014
  According to Harris Press Release[51], *Harris has deployed more than 35,000 AN/PRC-117G and 20,000 AN/PRC-152A radios worldwide. They are in use by all branches of the U.S. Department of Defense and more than 15 allied nations*. Important majority of these radios are delivered to U.S. forces.
- General Dynamics – Rifleman Radios: Total ~21 000 March 2014
  According to GD Press Release[52], *General Dynamics C4 Systems has delivered more than 21,000 PRC-154A Rifleman radios to the Army. (…) General Dynamics C4 Systems and Thales Communications manufacture the AN/PRC-154A Rifleman radios*.
- General Dynamics – Manpack Radios: Total ~5 000 June 2014
  According to GD Press Release[53], *With the completion of the current follow-on LRIP production order, the Army will own more than 5,300 PRC-155 Manpack radios*.

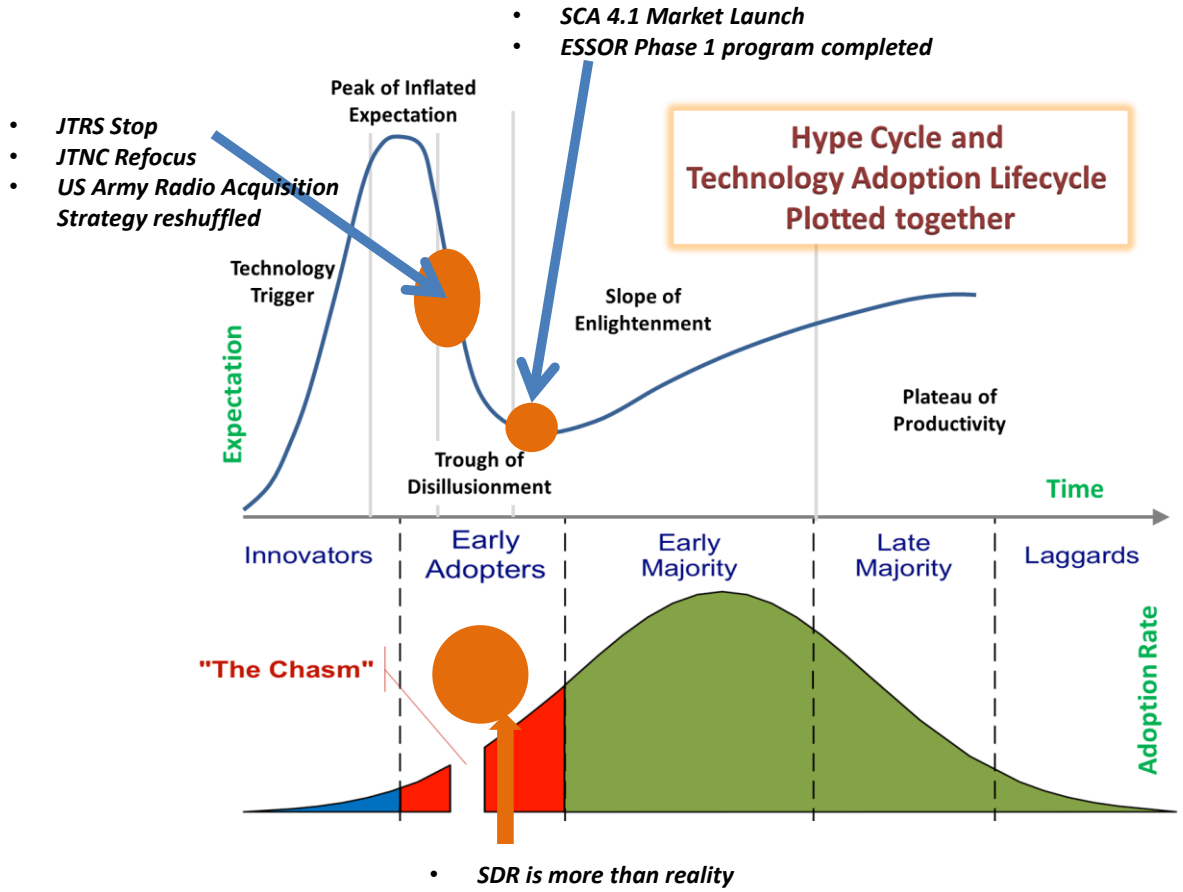
[50] PEO C3T – 2014 Portfolio – JTN Mission and JTN Portfolio - http://peoc3t.army.mil/c3t/docs/2014-Portfolio-Book.pdf

[51] Harris Press Release - Dec. 15, 2014

[52] GD Press Release – March 19, 2014

[53] GD Press Release – June 23, 2014

10 Annex - Hype and Technology Adoption Cycles with SDR and SCA Milestones



11 Annex - New Product Examples

11.1 Rafael and BNET

11.1.1 BNET Solution Overview

BNET is an advanced IP Mobile Ad-hoc Network (MANET) Software Defined Radio for tactical operations.

With unique high spectrum efficiency, as well as cognitive capabilities, the BNET offers exceptional connectivity, enhancing the exchange of information on the battlefield. Providing simultaneous voice, data and video communication, BNET is a major breakthrough in capacity, scalability, low latency and quality of service (QoS).

BNET technology is available in several configurations which make up the BNET Family: BNET-HH (Hand Held) for the soldier in the field, BNET-V (Vehicular) for operation on combat vehicles and BNET-AR (Airborne) for airborne platforms. All are interoperable with existing legacy radios and have the ability to interact with each other, meeting the demands of modern Net-Centric Warfare. (NCW)

Each member of the BNET family features:

- Flexible, high performance multi-band RF
- Instantaneous reception of more than 200MHz
- An integrated fully-featured IP router
- Accurate GPS receiver
- Frequency hopping MANET waveform
- Embedded power amplifier

The BNET supports legacy VHF/UHF (AM/FM) and an adaptive multi-rate mode that fits varying channel conditions. It is compliant with SCA 2.2.2.

11.1.2 Global Link - BNET Airborne SDR

Rafael is a veteran in the implementation of data and voice combat proven Net Centric Operation (NCO) solutions. The Global Link robust waveforms are based on over 15 years of deploying state-of-the-art communication systems to major air forces. These waveforms support simultaneous and robust data and voice services with multiple auto relays.

The Global Link (GL) system supports ease of use with high automation based on advanced MANET algorithms, reducing the workload of the fighters and avoiding the need for cumbersome and restrictive networks planning.

Global Link radio is a true SDR based on modular VPX architecture and implementation of the latest digital processing capability. This architecture supports “digital RF” with minimal analogue devices, enabling it to fit in a compact size two radios with two internal high power amplifiers and unique features, such as wide band reception of multiple networks.

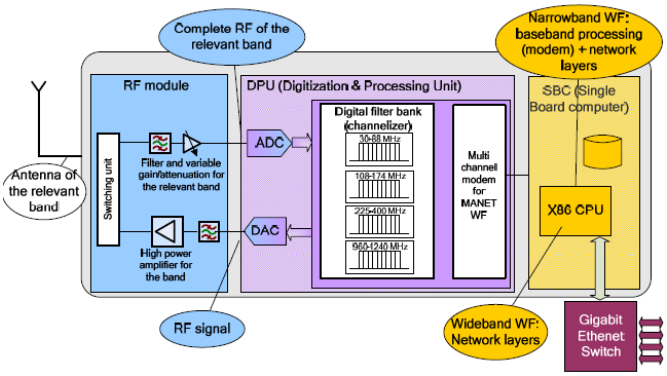
GL – Operational Capabilities

- True advanced SDR based on latest digital processing providing high performance & growth.
- ½ ATR compact system with simultaneous RF bands (VHF&UHF/L/S), providing the capabilities of 2-3 individual radios.
- Simultaneous support of legacy (AM/FM) communication and advanced Mobile-Ad-Hoc-Networking (MANET) waveforms with high capacity data, high quality digital voice and automatic multi-relays.
- Supporting higher utilization of the existing allocated spectrum
- High processing resources supporting advanced applications with full IP support.

11.1.3 BNET – Cognitive Capabilities

The BNET SDR implementation is based on the New Generation Highly Digital SDR architecture. This architecture leverages the processing revolution increasing the performance of programmable devices tenfold in the last five years with readily available high performance and cost-effective FPGAs and CPUs. It supports reception of the entire band and higher sensitivity than most current radios, while significantly reduces the amount of complex and power consuming analogue devices. BNET SDR is designed to provide maximum flexibility, employing a true SDR architecture using state-of-the-art sampling technology and advanced signal processing techniques, supporting ultra wideband sampling.

Cognitive network capabilities will be adapted into BNET using the inherent capability to simultaneously listen to all the networks in the system. This feature will use the radio as Spectrum Analyzer and "frequency holes" detector, supporting the network with the required information to gather, analyze and utilize collective network information, thus allowing the network to dynamically use the appropriate "spectrum holes". "Spectrum on demand" turns the whole spectrum available to all nodes.



11.2 Rohde & Schwarz and SDTR

11.2.1 SDTR solution overview

The SDTR is the first member of a new family of software defined tactical radios. It is intended for use in vehicles and in semi-mobile or stationary platforms. The software defined tactical radio SDTR is based on the current software communication architecture (SCA) version 2.2.2 and comes in conjunction with a family of high data rate (HDR) waveforms, that provide highly mobile units with secure, reliable high data rate communications links based on the Internet protocol (IP). In addition, the radio hosts numerous existing waveforms making it interoperable with legacy radios and therefore protects existing investments. The SDTR has 50 W output power (PEP and CW) and covers the VHF/UHF frequency range from 30 MHz to 512 MHz, has a compact size, and integrated co-site filters. Furthermore, Rohde & Schwarz is in the final phase of the development of the software defined airborne radio (SDAR).

11.2.2 HDR waveform overview

The high data rate (HDR) waveform family is fully IP-based and can transmit voice and data transmission simultaneously. The HDR waveforms allow the SDTR to be seamlessly integrated into existing IP networks.

- **HDR-WB (high data rate wideband)**
  Mobile networked, high data rates, medium range, low jamming immunity – for the best radio system performance in terms of network capability and data rate.
- **HDR-AJ-WB (high data rate anti-jam wideband)**
  Mobile networked, medium data rates, higher range, high jamming immunity – a good compromise between security and performance. The all-purpose wideband waveform.
- **HDR-AJ-NB (high data rate anti-jam narrowband)**
  Best possible data rate in tactical VHF band, best possible range, high jamming immunity, low spectrum requirements – for security and range in the classic 25 kHz VHF band. The network-capable high-performance narrowband waveform.

11.2.3 Security solution overview

The security architecture of the SDTR features strict separation of plain and encrypted data (red/black separation). In addition, the radio has two separate interfaces for control data and payload data.

Transmitted information needs to be protected against eavesdropping by using state-of-the-art encryption methods based, for example, on the advanced encryption standard (AES). Payload data encryption is referred to as communications security (COMSEC) and is an integral function of the HDR waveforms. Modern radios must protect networks and services against unauthorized manipulation, disruption and reconnaissance. The SDTR provides this ability, which is referred to as network security (NETSEC), by encrypting relevant information on the air interface and by using complex protection mechanisms in the waveforms.

Additional protection is provided by frequency-hopping methods implemented in the anti-jam (AJ) variants of the HDR waveform family. Frequency hopping is a transmission security (TRANSEC) technique. It enhances the jamming resistance in networks and therefore raises the sustainability of the defending forces. The combination of these features in the SDTR and the HDR waveforms allow secure communications even in challenging missions.

11.3 Selex and SWave

Italian investment in design and development of SDR platforms and waveforms products had a further impulse in 2011 with the launch of the SDR national program, more than 40 contractual batches under SELEX ES ownership, aimed at the development of platforms capable of deploying manifold waveforms with the purpose to make them interoperate with legacy, joint/combined (NATO, UE, Coalition) and inter-agency environments. The goal was to deliver secure communication modes and as many capabilities as the mission needs such as:

- CNR audio, data, video over different channels
- Mobile ad Hoc Networking (MANET)
- COMSEC certified up to Type 1
- Critical mission support

This enables Italian MoD to accomplish optimizations and scale economies in investments and logistics.

Program Scope is about the design and development of the SWave® family of SDR platforms, the SELFNET® family of networking new generation WF plus the heritage of the conventional legacy WF of the NATO STANAG suite. The platform family includes handheld, dual channel manpack; both together with VH adapters, and the four channel Vehicular radios. The program scope covers as well some feasibility study of airborne platform and initial design of Naval and Infrastructure SDR solution.

Within the Italian Soldato Futuro Program Selex ES has attained further major goals with the signature of a contract to supply 2726 radio SDR SWave handheld thanks to which the Italian Army's light infantry troops will be equipped with the new wideband communication systems, as reported by Selex press release 25th March 2014.

On 2 April 2014, Selex announced the first tests of the SWave Manpack with Italian Army. The product has been showcased at Eurosatory 2014.

11.4 Rockwell-Collins and TruNet

Rockwell-Collins has launched its new SDR product line using SCA technology, TruNet, on 30 March 2015[54]. TruNet delivers complete and integrated ground-to-air, ground-to-ground and air-to-air communications networking to forces on the battlefield. TruNet is a software defined network communications solution – including ground, airborne and handheld radio platforms, and advanced networking waveforms, to ensure secure connectivity between ground and airborne elements.

[54] Press Release Rockwell-Collins 30th March 2015 - Rockwell Collins unveils ground-breaking approach to military communications with launch of TruNet™ networked communications solution

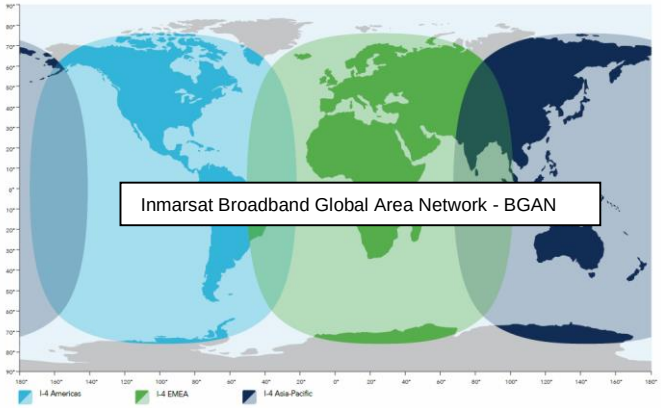
12 Annex – BGAN Waveform provider – Gatehouse Testimonial

Perspectives from a commercial waveform provider, based on lessons learned – so far.[55] - BGAN Waveform Portability Testimonial

12.1 Background

GateHouse is an established Inmarsat BGAN technology provider who has provided embedded communications software to BGAN terminal manufacturers since 2002. The proprietary BGAN technology is developed for use in a range of commercial products (except for a few products developed specifically for military use). There are, however, significant user groups within civil government and military entities due to its global coverage and ease of use.

In 2009, GateHouse and Inmarsat launched an initiative to develop a complete BGAN waveform for SDR, based on the existing components already provided to manufacturers for a number of years. The aim of the program was a) to offer a more complete, portable core technology package to existing and future terminal manufacturers, and b) to address the growing military SDR market well aware that significant military user groups were already established using just commercial terminals (COTS).



12.2 Waveform requirements

Based on a number of meetings with military SDR manufacturers, Gatehouse quickly learned that implementing the waveform to the level of full compliance with Inmarsat's requirements was just a part of the requirements which needed to be satisfied to obtain an attractive waveform product. Gatehouse was able to build the following list of requirements:

a. Generic WF implementation i.e. no assumptions about underlying hardware
   i. Flexibility in moving WF components between processing elements as seen fit
   ii. Typically, required bandwidth between processing elements is a concern
b. Comprehensive documentation, in particular platform requirements and external interface definitions
c. Comprehensive test harness
d. A reference implementation
e. Guidance/Assistance on integration, test and approval
f. Full follow-up technical support from WF provider

SCA compliance was not a definite requirement to begin with and Gatehouse did the first waveform implementation without support for SCA. However in 2013 Gatehouse decided to modify the waveform to support SCA 2.2.2 to make a more compelling offer for manufacturers of military radios. The SCA implementation was based on a 3rd part SCA Core Framework and went smoothly; Gatehouse got its SCA and JTRS API compliance certification November 26, 2013 after just 4 days at JTEL.

Two things are worth noticing

- SCA is just a small part of the total requirements for a waveform, and
- even though an offering as a waveform provider is technically complete, covering virtually all requirements, there are many more challenges in order to be successful.

12.3 Success criteria:

It is obviously very important to be able to satisfy all technical requirements, but Gatehouse has come across at least five major challenges of mostly non-technical character and which every waveform provider should consider carefully to be successful:

[55] WinnComm SDR 2015 Conference – Schumberg March 2014

- The customer will be totally reliant on the WF provider as a 3rd party IP provider. Seen from a customer viewpoint, it will be in control of a significant part of their products. This is seen as a risk as terms and conditions can change, as can priorities, etc. In the worst case, the WF provider can decide to terminate its business with consequences on support, etc., which is all out of the customers control.
- Being an independent waveform provider, it will be free to sell the waveform to other customers and thereby generate competition. Even worse, it would sell its business to a customer competitor.
- It is difficult for the customer to assess the market opportunities for the waveform. The customer may be confident about the market for their existing products including other (proprietary) waveforms, but a new waveform is typically considered a leap into rather unknown territory.
- There will be an effort to port, test and have approved the capabilities of the waveform. The customer may have an idea about the porting effort, but in particular the testing and approval effort is difficult to estimate, as it is closely related to the waveform.
- Radio manufacturers are inclined to sell their own waveforms for the above reasons, but also because of strategic and long term reasons; it is typically beneficial to tie end customers to proprietary technologies in order to earn additional, future business with them.

12.4 Perspectives:

Since 2009 where Gatehouse started to follow SDR technology developments and market requirements, things have progressed and Gatehouse is very confident the radio platforms (commercial and military) are moving toward becoming software defined, opening a market for waveforms. Gatehouse is also confident that the SCA standard and more so the overall philosophy to separate hardware and software is making waveforms more portable. However, Gatehouse concludes that for some time there will be a preference from hardware/radio manufacturers to promote proprietary waveforms leaving very little room for independent waveform providers. What is needed is end-users to require radio manufacturers to develop multi-waveform products or alternative separate the procurement of radios and waveforms, thereby creating an independent global market for waveforms.

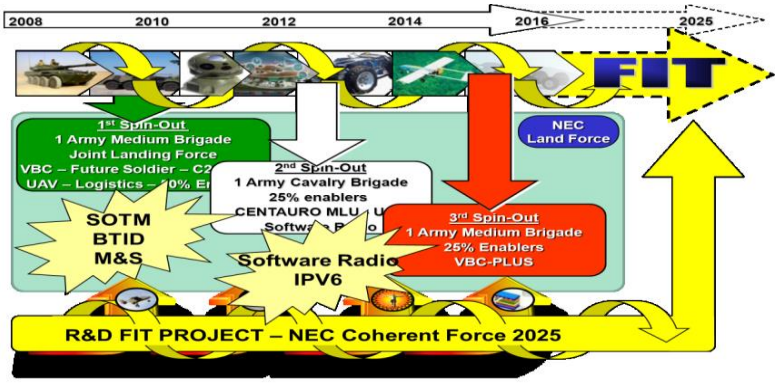
13 Annex - Italia – Forza NEC Program – Example of C4ISR Transition

Forza NEC is the digitization program of the Italian MoD. Forza NEC is a Joint Program and is mainly focused on the modernization of the future land forces capability. The vision of the Army chief of staff for this program can be summarized as follows: “To develop an array of network enabled land units fully integrated into the C4ISTAR Defense Architecture for Brigade size formation that is tactically strong, logistically sustainable and operationally flexible.”

The main goal of the first phase (2010-2018) of this program is to acquire a Digitized Brigade (Fo.Me.D. – Forza Media Digitalizzata), an Amphibious Landing Force (LFD – Landing Force Digitalizzata) together with Tactical and Expeditionary Enablers. Each military unit is operating tightly supported by the Decision Centre.

Forza NEC Operational Needs and Organization Trends involve several communication challenges:

- Relevance of expeditionary units: in OOTW the first phase of a conflict is often considered the most challenging from a warfare perspective. The role of entry-forces with expeditionary capability is crucial for mission success. Characteristics of these entry forces are:
    - joint-combined interoperability (ship-to-objective maneuver)
    - multi-role and multi-mission C4I equipment for maximum operational flexibility
    - heterogeneous digitized platforms (airborne, naval and land) with situational awareness populate multinational units composed from a joint capability basket
- Growing SATCOM capability to support extensive reach-back/reach forward activities reducing staff deployment in operational theatre
- Maximum Priority given to force protection (e.g. Anti-RCIED and CID) due to unpredictability of the operational scenario with the risk of mission creeping and fratricide casualties.
- Sparse Operations. AoR can exceed 40.000 Km2 for a Multinational Brigade thus the need for extended ISTAR capability and BLOS connectivity without ICT fixed infrastructure.



- MOUT. Military operations in urban environment have specific challenges affecting C4ISTAR equipment and platforms characteristics especially for mobility and local situational awareness.

14 References

The table below gives main references for information used to complete this report. It further completes the references already listed in the various sections of the report and directly inserted in the document. The first table includes items related to SDR programs (listed according regions, Asia, Europe and North-America (NA)) and the second table includes items related to SDR solutions.

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EDA	Europe	EDA - SDR Program web page	http://www.eda.europa.eu/our-work/projects-search/software-defined-radio
ESSOR	Europe	ESSOR at the MILCOM'13 and SDR WInnComm'14 conferences: ESSOR High Data Rate Waveform capabilities and the methodology for developing a portable coalition waveform software	http://www.occar.int/288
ESSOR	Europe	ESSOR Program Status	SDR WinnComm Europe 2014 - 5th Nov 2014 - Roma
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