Positioning the SDR Business Pendulum – The Case for an "Honest Broker"

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ABSTRACT

Historically the U.S. Government and Military have entrusted industry to deliver innovative products at competitive costs.

Various companies have succeeded in integrating diverse technologies and produced valuable radio product. However, economic self-regulation has not succeeded as equipment manufacturers have typically adopted a "non-cooperative" strategy that protects their investment by optimizing sales and profits on a localized scale. As a result, competition has been hampered and innovation / advancement of fielded technology diminished. This result is typified by the long lead-times associated with the transition of commercial technologies into the government / military sector.

Alternatively, "cooperative" industry development holds promise to allow a greater cross-section of researchers / developers to contribute and ultimately field advances in a more timely manner. The U.S. government has recognized the flaw in the historical business model and has taken a strong initiative to move the development trend toward open standards. As the balance is positioned in the other direction, the government has made a tactical decision to "own" the waveform definition and the deployed waveform realization. This represents an opposite extreme that has devalued the waveform implementations and has the potential to reduce industry participation due to lack of business motivation.

In the end, it is critical that a balanced business case be defined for both suppliers and consumers. This paper identifies key characteristics of an "Honest Broker" that can yield a balanced Software Definable Radio (SDR) business environment.

1. INTRODUCTION

An example will prove sufficient to demonstrate a weakness in the historical radio procurement cycle. The SINCGARS radio is a piece of workhorse communications gear for the U.S. Army and is manufactured by ITT in Ft. Wayne, Indiana for CECOM. The government funded the majority of the development of this ECCM radio and ITT continues to hold the implementation as corporate IP. General Dynamics in Tallahassee Florida was selected to provide a second source for the SINCGARS radio. This design was produced from the Government Specifications and demonstrated to interoperate with the ITT implementation. Over time, the radio's ubiquitous use in the U.S. military has resulted in other related products from such companies as Motorola, Harris, Raytheon, Rockwell, Assurance Technology, RACAL, and Nova. Since the original SINCGARS implementation is proprietary to ITT, most developers were forced to reinvent the technology implementation from a government specification.

Consider an average cost of $4M per company to produce a partial SDM / EDM / ESIP SINCGARS implementation and that availability of a reference SINCGARS source library could cut this cost by 75%. This implies that the government has spent nearly $32M re-inventing SINCGARS vs the $8M required to adapt a reference source library.

This "non-cooperative" model is not specific to SINCGARS and currently represents the "industry standard" business model for legacy waveforms. Such de facto "ownership" can be lucrative for the companies that hold the IP but leaves the end user to bear the disadvantage associated with a monopolistic market position.

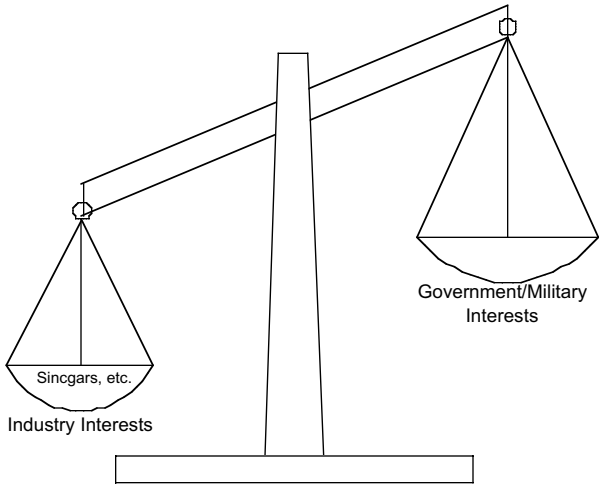

Figure 1: Historical Non-Cooperative System (Industry Driven)

The equilibrium that has resulted under the "non-cooperative" strategy is obviously sub-optimum with regards to the application of corporate and government technical, programmatic, and financial resources While the legacy "owners" have evolved and improved the waveforms' performance over time, it's safe to say that the best ideas from industry have not penetrated the designs.

The JTRS program identifies a paradigm that holds promise to break through the limitations of a non-cooperative strategy whereby the government takes ownership of each waveform and distributes the implementation onto a set of manufacturer-specific SDRs. In the JTRS procurement cycle, there are essentially five classes of participants that include the Government Users, Government Suppliers, Systems Integrators, Radio Manufacturers, and Waveform Suppliers.

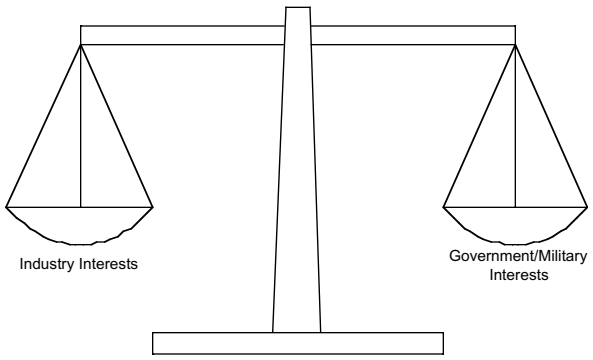

Figure 2: Desired Cooperative System

This paper begins with an overview of the results that the JTRS program is designed to accomplish and defines a primary barrier that it must overcome. Next, a brief synopsis is provided for the primary "process standard" (Software Communications Architecture or SCA) that is used to drive the initiative. Given the results and the driving standard, the questions of feasibility for accomplishing this objective is posed and criteria summarized that will support its success. This is followed with an identification of three weaknesses in the current process and a suggestion on how an Honest Broker can catalyze the JTRS cooperative process.

2. JTRS OBJECTIVE

The outcome to be realized from the JTRS program is to field communications gear that concentrates operations to a smaller inventory of equipment that will result in a significant reduction of logistics costs. The JTRS strategy for procuring open waveforms is intended to break the non-cooperative cycle. The ability to freely distribute a reference implementation will reduce procurement costs by diminishing the need to reinvent the waveform for alternate radio realizations. Software downloads are applied to facilitate upgrades thereby improving the users capabilities while increasing the life-cycle of the equipment. Product technology insertion will result as never before given an increase in contributions by the best-of-class waveform designers (enabled by a cooperative strategy).

A conjecture, based on empirical observation, is that the so-called not-invented-here (NIH) syndrome is a strong force in the technology culture that continues to work against the cooperative initiative. Typically, business decision makers in the technical industries are highly dependent on evaluations by their technical staff. The technical groups are highly optimized around their skills to solve technical problems and prefer to exercise these skills. Therefore, the decision process, that is highly dependent on the technical advisors, has a built in bias toward a non-cooperative strategy. Therefore, the JTRS project must seek to overcome the inertia of the non-cooperative strategy. It is well recognized that such culture changes are difficult to produce. The most likely contributors to the cooperative JTRS initiative are those corporate entities that can demonstrate solid technical capability and an inherent resistance to the NIH syndrome.

3. SOFTWARE COMMUNICATIONS ARCHITECTURE (SCA)

Under a competitive development cycle, the JTRS Joint Program Office (JPO) awarded a contract to Raytheon and other industry partners to specify the Software Communications Architecture (SCA). The current SCA (version 2.2) has been released to industry by the Modular Software-programmable Radio Consortium (MSRC) and is published by the Joint Tactical Radio System (JTRS) Joint Program Office (JPO).

This standard is intended to establish a framework on which suppliers can integrate common operating objects and services that comprise the radio operations. By achieving an objective to field reconfigurable devices, the government expects to greatly increase the operational flexibility of a given piece of equipment thereby reducing the inventory of hardware required and associated costs. Moreover, equipment designed to this standard will be open to a broader range of developers thereby mitigating a barrier to timely technology insertion.

The SCA attempts to leverage commercial standards to realize portable software objects and supporting devices. The specification includes definitions for the infrastructure components such as the Operating Environment, Core Framework, CORBA middleware, and a standardized operating system interface (POSIX). An application (e.g., waveform) consists of a set of operating objects that execute on top of the CORBA middleware. The objects are registered with the Domain Manager that serves as an "address service" to a given set of objects. Objects are specified to inherit a set of core services and intercommunicate via well-defined Ports.

An assessment of the SCA reveals that its definition applies the commercial Common Object Request Broker Architecture (CORBA). This represents a major paradigm shift in the deployment of radio software and is an unproven risk with regard to industry acceptance in support

of radio operations. The adoption of this approach certainly limits the field of processor applicability. An assessment of the processor industry shows that general purpose Intel x86 and Motorola/IBM PowerPC processors are the primary targets. The existing tools for Digital Signal Processors that are on the market today do not include CORBA. The SCA strategy therefore requires most DSP and FPGA devices to be accessed via an SCA API residing on one of the processors that support CORBA.

4. IS THE JTRS OBJECTIVE REALISTIC?

The U.S. Government and it's military are a powerful influence – but their technology initiatives eventually succumb to fundamental market forces.

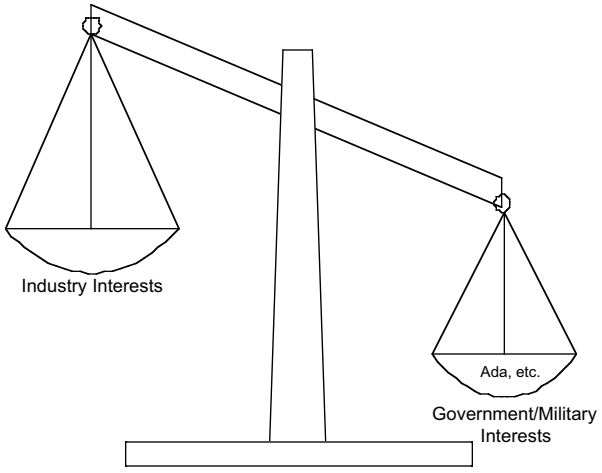

Figure 3: Historical Non-Cooperative System (Government Driven)

Remember Ada—a software language that was "mandated" for use on government programs. The Ada language is all but extinct and there are many reasons why it failed. These are related to disparity with the commercial industry that produced more mature tools and supported the company cultures at a level where Ada could not compete. The Ada language enforced many of the goals of a mature software life cycle but was eventually overtaken by the market factors.

A question that bears consideration is whether the JTRS initiative will fall into obscurity like the Ada programming language. The SCA is a highly visible component of the initiative and will need to evolve to the markets input over time while balancing the need to prove itself on the lab bench. As the government takes ownership of the SCA, it must struggle to become and remain relevant. For example, programmable logic devices are emerging that can be reconfigured in microseconds in contrast to current devices that require hundreds of milliseconds to configure. This is representative of a technology to be enveloped by the SCA.

Driven by the motivations of a cooperative strategy, the government must continue to incite/entice industry to produce hardware, software, tools and processes that demonstrate results compatible with the commercial industry. This "applied research" project will need government support until it reaches a point where the commercial industry can reap three advantages: consumer use advantages (life-cycle improvement via functionality upgrades), consumer purchase advantages (low cost), and consumer convenience advantages (low power / portability).

5. ASSESSMENT OF CURRENT BUSINESS MODEL

The well-balanced business case is critical to the success of the SDR initiative. Preceding efforts with similar goals (e.g., SpeakEasy) have not directly resulted in manufactured product but were useful in understanding the costs to achieve the value-added tenants of an SDR. The lessons learned from such efforts further demonstrated that proprietary SDR products held by individual companies can gain little acceptance in the industry at large. It will become increasingly difficult for the JTRS / JPO to hold their resolve to establish cooperative radio products as funding is consumed and their customers demand product. Pressures that will erode the government / industry resolve are typified by the aggressive schedules and associated expectations that are communicated through a lineage of delegates up to the decision makers but do not reflect some of the lessons learned on earlier SDR developments. If these procurements can maintain their confidence and patience to reward the emergence of cooperative products and penalize non-cooperative offerings, the goals to entice the best of breed can be realized.

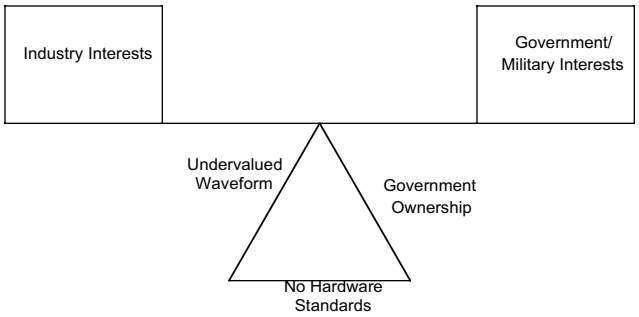

Figure 4: Proposed Cooperative System is Unstable

An assessment of the current model has suggested at least three basic weaknesses.

1. Standards for the JTRS hardware products and supporting tools do not exist. Under the current JTRS programs, the radio providers are allowed to deliver highly integrated hardware to internal standards. Given

historical performance, the radio providers will be motivated to deliver products that require their participation. Even tools, process, or infrastructure components (e.g., Core Framework component of the radio) that are not open can hinder third party participation.

2. The waveforms are undervalued which diminishes participant initiative. The government has dismissed the concept of per-unit royalties citing significant logistical issues and now seeks ownership of the waveforms in the JTRS procurement. In reply the hardware providers have verbally consented. The return on SCA waveform investment is a modest licensing fee for IP and profits on engineering services work. There is no long-term financial incentive defined that will encourage investment.
3. For lack of a better business model, industry participants are establishing a latent opportunity to regain position in a non-cooperative market by limiting government ownership of waveforms to government purpose use on the JTRS Cluster programs.

The long-term affects of these weaknesses will hinder the cooperative initiative of the JTRS. Many legacy providers cultures are naturally driven to put a cooperative face on a non-cooperative approach as they seek to protect their investment using historically effective tactics. If this prevails, future companies that truly offer the advantages of a cooperative system will not achieve a sustainable economic advantage that will allow emergence of JTRS-objective systems.

6. POSSIBLE MODEL IMPROVEMENTS

To restate, the JTRS cooperative initiative will become self-sustaining when it's advantages are proven, realized and adopted by the commercial industry. Three suggestions are provided to move toward this objective relative to the issues identified in the previous section.

Suggestion #1 – Identify an Honest Broker

The likelihood for reaching the cooperative objective can be substantially improved if an "Honest Broker" is added as a participant in the development cycle. Identification of this group is beyond the scope of this paper. However, it is a given that neither the Government Users, Government Radio "stakeholder", System Integrator, Radio Manufacturers, Tool Providers, or Waveform Providers can independently act as the Honest Broker. Some measure of independence should be applied to avoid the tendency to move back to a non-cooperative strategy.

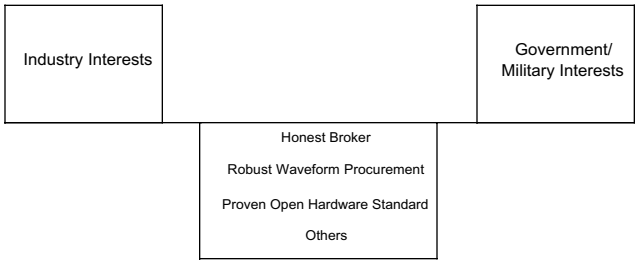

Figure 5: Improved Cooperative System Could be Stable

Suggestion #2: Open Hardware Standards

An SCA Platform Architecture (SPA) should be defined to specify the module interfaces, real-time interfaces, and formally adopt SCA and primitive non-SCA software objects. In the current process, substantial costs are incurred as developers independently collect the key performance parameters across all the waveforms and apportion them to their particular waveform application for SDR. The instantiation of the waveforms will be inconsistent across platforms and will add substantial risk to waveform portability. Attention to this area will add lasting value to the cooperative JTRS initiative.

Suggestion #3: Vitalize the Waveform Procurement Model

The JTRS program structures inherently discourage the participation of waveform developers from a business perspective. There exists a balance that is market dependent that would attract most of the feasible waveform suppliers and supporting participants. The Honest Broker should research the tradeoffs and identify improvements to the model that support a financial return to successful waveform providers. This balance will change over time and should be re-evaluated based on identifiable market metrics. As a result, more optimized applications will result and the rate of beneficial technology insertion will increase.

7. CONCLUSION

This paper has recognized the goals of the JTRS program and identified that its success is dependent on its ability to transition into the mainstream commercial markets when it matures. Three issues were defined that are perceived as barriers to reaching the supporting aspects that will realize a risk/reward offering required to attract the best in the industry. Several suggestions that address these issues were provided, recognizing that a successful JTRS program will be determined by market influences. An Honest Broker program role was identified to act as a catalyst for the cooperative initiative.