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Comparing open source and commercial off-the-shelf software

Initial comparison

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Abstract

This document presents a methodology to compare an open source to a commercial-off-the-shelf software solution. This is discussed and demonstrated by way of an initial comparison between OpenShift Origin (Open Source) and Red Hat OpenShift Container Platform (Consumer off-the-shelf). The assessment is that OpenShift Origin provided the best solution for the identified criteria. Further the methodology was judged to be adequate for an initial evaluation.

Significance to defence and security

The methodology used in this document can be used in the evaluation of future software solutions for the Royal Canadian Navy (RCN). Also the methodology can be used as the first step in developing a more involved process.

Résumé

Dans le présent document, on décrit une méthodologie permettant de comparer une solution logicielle ouverte à une solution logicielle commerciale. Une première comparaison entre la solution OpenShift Origin (logiciel ouvert) et la solution OpenShift Container Platform (logiciel commercial) de Red Hat a permis de procéder à une analyse et à une démonstration. Ainsi, on a déterminé que la solution OpenShift Origin s'avérait celle qui répondait le mieux aux critères énoncés. En outre, la méthodologie a été jugée adéquate pour une évaluation initiale.

Importance pour la défense et la sécurité

La méthodologie décrite dans le présent document pourra servir à évaluer de nouvelles solutions logicielles pour la Marine royale canadienne (MRC). En outre, elle peut constituer une première étape en vue de l'élaboration d'un procédé plus complexe.

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1 Introduction

Next Generation Naval C2 Systems project (01da) was in part established because of the Royal Canadian Navy (RCN) identified need to upgrade or replace the Global Command and Control System Maritime (GCCS-M). In the current state of technology, there are two predominant software categories: Open Source and Commercial off-the-shelf (COTS). With this in mind, there was a need to consider the two categories of technologies from the perspective of a future Command and Control (C2) system. There are other categories such as a custom development or a mixture of categories. It was decided for this document not to consider these categories.

The 01da project charter identified advice related to enabling technologies as a key sponsor deliverable, with the advice identified as potential input to the RCN's business case for upgrading or replacing GCCS-M. The 01da Project Management Plan (PMP), under Work Breakdown Element (WBE) 1.6.2.i, identifies the provision of advice on Open Source versus COTS to the client. This reference document fulfills that key sponsor deliverable.

1.1 Purpose

The purpose of this document is twofold.

First, the document is to provide an initial comparison of the benefits and drawbacks of Open Source vs. COTS for products that manage the roll-out of cloud services, the distribution of cloud resources, and the monitoring of performance. This is the working example of the paper. Recommendations are given in the conclusion section of this paper based on the analysis. However, this document should not be seen as comprehensive, one Open Source and one COTS product were compared. There are more than two possible solutions. This leads to the second purpose of this document.

The second purpose is to provide a method for an initial comparison of Open Source and COTS products. Using the Evaluation Criteria outlined in this document, a similar comparison could be repeated for other products and purposes.

1.2 Terms

Open Source product: A software product developed by a community of developers, can be modified by the end-user since it includes access to source code, and is typically free for consumers (depending on the licensing model used for that project).

Commercial off-the-shelf (COTS) product: A software product that is generally developed in a proprietary manner by a company, used as-is out of the box, and sold to consumers.

1.3 Explanation of the example

This document takes the approach of comparing OpenShift Origin (Open Source product) and Red Hat OpenShift Container Platform (Consumer off-the-shelf product). Both of these software packages are

used to manage the roll out of cloud services, the distribution of cloud resources, and the monitoring of performance.

This example was chosen to limit the scope of the document while still providing both a methodology for evaluation and a comparison of the two types of software products.

It should be noted that both of these products are produced by Red Hat Inc.

2 Methodology

In order to evaluate competing options, a consistent procedure should be used to avoid bias by the evaluators. Since this is an initial evaluation, the specific requirements for a developed C2 system are unknown. Therefore, a methodology was designed combining brainstorming and use cases (Annex A) for requirements gathering. The requirements were then ranked by a group consensus among the evaluators. The evaluators are aware of several other formal requirements gathering methodologies, such as, Document Analysis, Observation, Prototyping and Reverse Engineering [1]. The following method was selected due to the need for both high level requirements (brainstorming) and technical requirements (use cases).

To perform the comparison of OpenShift Origin and Red Hat OpenShift Container Platform a brainstorming session was conducted to generate possible evaluation criteria. After all the criteria were generated, the list was prioritized according to perceived importance of the criteria to the development of a C2 system, from the perspective of the evaluation group. It was then decided that a threshold would be applied, above which are the critical requirements. In this context, critical means that in the eyes of the evaluation group, failure to meet the criteria would result in rejection of the solution.

The complete evaluation criteria list is provided in the following section along with cut off threshold. It should be noted that a different order or list of evaluation criteria might be generated by a different evaluation group. For example: Cost may not be a factor for the technical group trying to implement a solution but training availability might be significant. For project management, cost might be the only factor.

3 List of possible criteria

The complete list of possible evaluation criteria is supplied below. Complete descriptions for the criteria used in the evaluation are provided in the section for that evaluation. Since the criteria below the threshold were not used further, descriptions were not developed.

Table 1: *Sorted criteria.*

Order	Criteria
1.	Cost
2.	Fit for purpose
3.	Documentation
4.	Technical support options
5.	Level of functionality
-----Threshold ----	
6.	Ease of installation
7.	Training availability
8.	Version control/versioning/product fragmentation
9.	Adoption in community
10.	Maturity
11.	Ongoing development (vs. orphaned)
12.	Hardware requirements
13.	Operating system requirements
14.	Infrastructure impact
15.	Life cycle management e.g., requirements-design-development-deployment-maintenance

4 Evaluation criteria

4.1 Cost

Cost was determined to be one of the primary concerns for a comparison between OpenShift Origin and Red Hat OpenShift Container Platform. One advantage of using cost was that the value is easily determined and is not subject to interpretation.

The cost was further broken down into three types of cost:

1. Overall—Includes initial and ongoing costs for five years.
2. Initial—Start-up cost. If cost is per unit (e.g., machine, socket, core) that will be noted.
3. Ongoing—Licensing and maintenance costs per year. If cost is per unit (e.g., machine, socket, core) that will be noted.

Table 2 summarizes the cost comparison.

Table 2: *Cost comparison.*

Criteria	OpenShift Origin	Red Hat OpenShift Container Platform	Notes
Overall	$0	Greater than $10,000 Canadian	Origin is free to download and use.
Initial	$0	Greater than $10,000 Canadian	Red Hat pricing is not publicly available. It is based on per-unit pricing. In this case, it is for a single machine with 1–2 sockets.
Ongoing	$0	Greater than $10,000 Canadian	Ongoing costs from Red Hat are the same as the start-up—there is no premium for initial purchase or discount for subsequent years.

As can be seen in Table 2 the $0 dollar cost of OpenShift Origin is a clear advantage over the cost of Red Hat OpenShift Container.

4.2 Fit for purpose

The evaluation team felt that when comparing the software options, it was important to make sure the software performed the requirements for the job. Since the authors did not have access to a complete set of requirements it was decided that two use cases, described in Annex A, would be considered. Each type of software was evaluated on how well it met the requirements of the use cases.

How the different software was judged is shown in the Table 3.

Table 3: *Task comparison.*

Criteria	OpenShift Origin	Red Hat OpenShift Container Platform	Notes
Use Case A	Meets Fully	Meets Fully	While both meet the requirements of the use case, the immediate availability of technical support offered by Red Hat is important. If an issue arises prior to software distribution it must be dealt with quickly and this is only possible with paid, on-call support.
Use Case B	Meets Partially	Meets Partially	Both can support the requirements of this use case but there are some required capabilities that are beyond the scope of OpenShift. The management aspects of OpenShift would have to be augmented to recognize and handle trade-offs between communications and processing capability between two or more OpenShift instances.

The evaluation of the requirements for the task in hand is very similar for both products with slightly better management capabilities for Red Hat OpenShift Container Platform.

4.3 Documentation

In order to evaluate choices between two software options it was determined that the quality and availability of documentation would be used as evaluation criteria. The evaluation team determined different categories as listed in Table 4 below and if the category of documentation was available for the software being evaluated. The intention was to determine a yes or no value for the category of software but it turned out the quality within the categories was not the same. As a result further explanation was provided.

Table 4: *Documentation comparison.*

Criteria	OpenShift Origin	Red Hat OpenShift Container Platform	Notes
Released document	Yes	Yes, greater access with paid license fees.	
Online forums	Yes	Yes. Forum questions are answered more readily by Red Hat technical support.	
Tutorials	Yes	Yes. Red Hat supplies specialized tutorials with paid license fees.	
Walk through	Yes	Yes. Red Hat supplies specialized walk throughs with paid license fees.	
Up to date	Yes, gets updates first	Yes, with a slight delay in comparison to OpenShift Origin. To generate an official release results in an approximate one month delay.	
Third party	Yes	Yes	There are books, blog articles, and other third party documents available for both free and paid versions.

Table 4 shows that Red Hat OpenShift Container Platform provides additional documentation to the user. A member of the evaluation team noted that the quality of the Red Hat OpenShift documentation was superior to that of OpenShift Origin.

4.4 Technical support options

The evaluation team recognises that during implementation there will be situations where access to external expertise is important. The expertise may provide support in the form of advice, implementation techniques, code solutions, etc., thereby saving implementation resources. The important types of support, as well as cost, are identified in Table 5.

Table 5: *Technical support comparison.*

Criteria	OpenShift Origin	Red Hat OpenShift Container Platform	Notes
Cost	Unknown	Included in license cost.	No direct equivalent. Paid technical support options are available for Origin vs. Red Hat version of OpenShift, however, contracted consultants may be available.
Online	Yes	Yes—and email.	
Voice	No	Yes—typically provided as a call back to a submitted trouble issue.	
Forums	Yes	Yes. Access to private Red Hat forums monitored by staff.	
Training	Yes	Yes	

Table 5 clearly shows that the technical support of Red Hat OpenShift Container Platform is superior to the support available with OpenShift Origin.

4.5 Level of functionality

4.5.1 Overall

The evaluation team decided that the software could be evaluated across several categories of functionality or capability. These capabilities can each have significant effect on the suitability of a particular solution. These capabilities are listed and evaluated in Table 6.

Table 6: *Compatibility/Functionality comparison.*

Criteria	OpenShift Origin	Red Hat OpenShift Container Platform	Notes
New features and improved functionality in new versions.	Capability is increasing across versions.	Capability is increasing across versions.	
Usability	Steep learning curve.	Steep learning curve.	
Maintainability	Limited	Limited	The change from OpenShift Origin Version 2 to Version 3 and Red Hat OpenShift Container Platform Version 2 to Version 3 was significant and required reinstallation instead of upgrade. With Version 3, upgrades from one minor version to another (e.g., 3.3 to 3.4) can be performed.
Scalability	Core capability but user must still setup properly (i.e.—not automatic)	Core capability but user must still setup properly (i.e.—not automatic)	
Reliability	Origin has newest features which may not be as stable/fully tested.	Red Hat fully evaluates and tests before releasing to customers.	
Extensibility	Straightforward to add new containers/capabilities.	Straightforward to add new containers/capabilities.	
Security	Industry standard.	Industry standard.	

The comparison of compatibility and functionality is very similar in most criteria except that of reliability. OpenShift Origin is focused on delivering new features and options as fast as possible while the focus of Red Hat OpenShift Container Platform is to provide a more stable and reliable platform. For this reason the evaluation team assesses that OpenShift Origin would be better suited for research while OpenShift Container Platform would be better suited for an operational environment.

4.5.2 Compatibility with partners

The evaluation team realized that in order for software to be useful it would have to support interoperability to partners. The types of partners were identified and if the software would be compatible with the systems was assessed. The evaluation team did not have access to the systems the partners would use to integrate with. As a result, the evaluation team considered if Openshift Origin or Red Hat OpenShift Container Platform created any obstacles that would prevent connectivity. An answer of yes in Table 7 indicates no perceived obstacles.

Table 7: *Compatibility with partners' comparison.*

Criteria	OpenShift Origin	Red Hat OpenShift Container Platform	Notes
RCN	Yes	Yes	
Foreign Governments	Yes	Yes	
Industry	Yes	Yes	

The evaluation of compatibility with partners resulted in no clear advantage of one product over the other.

4.5.3 Compatibility with existing systems

Not only does software need to be compatible with partners, it must be compatible with systems in use and planned for the future. The evaluation team took as an example the Royal Canadian Navy's Recognized Maritime Picture environment, GCCS Canadian Interface Plus (GCI+) and determined what would be required to integrate the existing version and future plans with both Red Hat products.

Table 8: *Compatibility with existing systems.*

Criteria	OpenShift Origin	Red Hat OpenShift Container Platform	Notes
Existing—Production	Yes—with caveats. The compatibility relies on components being available on the Operating System. Such as Apache.	Yes—with caveats. The compatibility relies on components being available on the Operating System. Such as Apache.	
Existing—Planned	Yes—with caveats. The compatibility relies on components being available on the Operating System. Such as Apache.	Yes—with caveats. The compatibility relies on components being available on the Operating System. Such as Apache.	

Both products are equally suitable based on the compatibility with existing systems.

5 Lessons learned

Evaluation Criteria 1, 2, and 3 were easiest to assess as they described clearly defined benchmarks for the software to be evaluated against.

6 Evaluation conclusions

For the specific case of choosing OpenShift Origin or Red Hat OpenShift Container Platform, a deciding factor was the experience level of the intended user. The experience level of the intended user was not initially identified as an evaluation criterion. The experience of the user was determined to affect the impact on multiple evaluation criteria. Specifically documentation and technical support. If the user had expertise in the problem domain an Open or Free solution would be adequate. If on the other hand the user was inexperienced in the problem domain, a Commercial off-the-shelf solution added better support options in both the quality of documentation and the ability to directly consult subject matter experts. This factor could also be used in the more general case of Open Source vs. COTS. Another factor that was significant is the operation level of the intended use. On the research side the Open Source solution provides more for custom solutions. While on the operational side reliability of the COTS product is more important.

Cost can be an overwhelming factor. Following a paper evaluation of competing software, if the advantage of COTS is not significant, the cost may not be justified.

In the particular evaluation of OpenShift Origin or Red Hat OpenShift Container Platform the authors concluded that OpenShift Origin was a better fit for an experimental environment. Expertise was expanded by the organization to a level adequate to develop an OpenShift Origin solution. Further the annual fees for the Red Hat OpenShift Container solution was found prohibitive.

At the higher level of OpenSource vs. COTS the method described in this document was determined to be suitable for a first pass comparison. It allowed the evaluators to quickly identify and prioritize their evaluation criteria, perform the evaluation, and come to a decision.

References

[1] Dehra, N. and Bowen, R. (Ed.) (2011-05-19), Techniques Used in Business Requirements Gathering (online), http://www.brighthubpm.com/project-planning/60264-techniques-used-in-business-requirements-gathering/ (Access date: 2017-10-17).

Annex A Use cases

These use cases have been generated based on knowledge of the Command Reconnaissance, Area Coordination and Control, Environmental Network (CRACCEN) and Canadian Surface Combatant (CSC) documentation.

A.1 Use Case A: Management of resources for deployment

This scenario is about the pre-deployment preparation of the vessel, be it a surface or subsurface platform. The vessel's computing environment needs pre-deployment preparation, where applications and supporting information resources are loaded while the vessel is still tied up.

The on-vessel cloud must allow the loading of applications and information resources. For applications, we image a numerical computation such as a model that may use a common information resource. This resource may be from another installation.

The information resources must be managed ashore, to ensure the proper version gets deployed. Issues related to deploying different versions of applications or resources to different vessels, must also be managed. Knowledge of the different versions should be available to the cloud participants.

Updates to the information resources also need to be captured and made available when the vessel returns. For example, a loaded image of a database needs to be capable of reincorporating the changes made while at-sea, back into the originating system.

Updates across vessels should also be possible. A vessel may deploy with Version 1 of some application or resources, and then join a common cloud environment where Version 2 of the resource exists. After checking compatibility, V1 could be replaced with V2.

A.2 Use Case B: Distributed processing

Suppose a cloud environment exists on two vessels; a large and very capable cloud in one environment, and second, modest cloud on a second vessel. Suppose a third vessel now wants to utilize the two cloud environments.

The third vessel can utilize both clouds, assuming it has a means to differentiate the communication and processing capabilities. For example, the modest cloud may be more effective if communications to that cloud are excellent. However, if communications are poor, the modest cloud could still be leveraged if there were applications existing on the modest cloud that were known by the third vessel and that could be initiated via semantically meaningful messages. This really means the multiple clouds are capable of recognizing the tradeoffs between communications and processing capability.

In this scenario, simpler processing tasks are only transferable to the modest cloud if the requests are within the limits of communications and the available message content.

List of symbols/abbreviations/acronyms/initialisms

C2	Command and Control
COTS	Commercial off-the-shelf
CRACCEN	Command Reconnaissance, Area Coordination and Control, Environmental Network
CSC	Canadian Surface Combatant
DND	Department of National Defence
DRDC	Defence Research and Development Canada
DSTKIM	Director Science and Technology Knowledge and Information Management
GCCS-M	Global Command and Control System Maritime
GCI+	GCCS Canadian Interface Plus
PMP	Project Management Plan
RCN	Royal Canadian Navy
WBE	Work Breakdown Element

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Global Command and Control System Maritime (GCCS-M), GCCS Canadian Interface Plus (GCI+), Command Reconnaissance, Area Coordination and Control, Environmental Network (CRACCEN), Naval Cloud, Open Source, Commercial off-the-shelf (COTS), Command and Control (C2)