

Turbo FRMAC Cloud Solutions

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Executive Summary

The software team that develops Turbo FRMAC (TF) at Sandia National Labs has continued to look for technologies to add Cloud-enabling features to Turbo FRMAC. The Amazon *AppStream* service has now matured into a viable low-cost solution with quick turnaround potential to create a Cloud version of Turbo FRMAC. This service would allow *both* a Desktop and Cloud version of Turbo FRMAC to exist without duplicate efforts to support both instances. The only software needed to run is a modern Web Browser – no downloads and no installation necessary.

Introduction

In 2013, Turbo FRMAC took the first step toward moving into a Web environment. The existing Web solution uses Java Web Start technology to deploy the application over the web and provides an identical user experience as the Desktop version. This also allows TF to be cached locally, in case it needs to be run offline if an internet connection is not available. While Java Web Start provided a new opportunity for accessing Turbo FRMAC from the web, there is a desire for improvement. This report describes the current avenues being pursued and the decisions considered to further advance Turbo FRMAC as a Cloud-enabled application.

What is involved to put applications into the Cloud?

In a Cloud environment, software and services run on the Internet instead of running locally on a computer. Most Cloud services can be accessed through a Web browser, and some companies offer dedicated mobile apps. The Cloud *does not* host applications, so you cannot just put an app in the cloud and expect maximum performance and scalability without proper modification and design. Depending on the Cloud services utilized, the initial investment can be costly and time-consuming to redesign large applications that have been traditional desktop applications. What are our options to start taking advantage of Cloud computing to make Turbo FRMAC more available to users?

What avenues are currently being explored?

Multiple avenues are being explored to move Turbo FRMAC into a Cloud environment or to at least leverage some Cloud-computing functionality within the existing Desktop version of the software.

AppStream @ SNL

SNL has put together a plan that utilizes version 2.0 of the AppStream service provided by Amazon Web Services (AWS). This solution would take the existing Desktop instance of Turbo FRMAC and add the necessary modifications to make it AppStream-compatible. SNL's Cloud infrastructure team will also configure the AppStream environment for Cloud-enabled access to the software. Permission to proceed with this effort was approved by the SNL External IT Services (ExITS) team in June 2018, which is a requirement for any SNL-developed application to undergo. We have accumulated information about the costs to provide this service on an annual basis, relating to the typical number of users expected, and possible scalability costs if a real event were to occur. At the moment, the labor for the Cloud infrastructure team is paid by the ExITS department's budget and CM funds are not being used for Turbo FRMAC Cloud development. Note that in CY 2016-2017, version 1.0 of the service was considered but

proved unviable due to that it required network port access that many government agencies' computer security policies will not allow. Version 2.0 of this service can run the application via a modern web browser like Firefox or Google Chrome and is not limited by the network port access as was version 1.0. A proof of concept has been built using version 2.0 of the AppStream service and solves the problems that could not be overcome with version 1.0.

Microsoft Azure Cloud @ PNNL

A joint proposal with PNNL was put forth to the FY18 NIRT program which would investigate the Microsoft Azure Cloud platform. This proposal sought to identify the appropriate path forward to bring Cloud-enabled technologies to Turbo FRMAC (TF) under the SHIRE and DOE Radiological Emergency Response (DOERER) common user credentials. The goal of this work is to make Turbo FRMAC Cloud-enabled and more available to users on the Microsoft Azure Cloud platform. This Cloud platform provides an opportunity for data sharing within and across response organizations, and integration with other FRMAC tools. This proposal is limited to (1) making short-term Cloud-enabling enhancements to the Desktop version of Turbo FRMAC to communicate with the SHIRE environment, and (2) to scope out the long-term possibilities of turning Turbo FRMAC into a Cloud application that is hosted by PNNL's Microsoft Azure Cloud environment.

A goal of the joint proposal with PNNL is to determine if Microsoft Azure provides a comparable service to Amazon's AppStream's service. The current knowledge suggests that Azure no longer provides such a service. Prior to 2017, Azure provided a service called *RemoteApp* but discontinued that service in favor of Citrix virtualization technologies (Foley, 2016). Part 2 of the proposal would definitively answer this question.

Major Considerations Moving to the Cloud

The decision to move Turbo FRMAC into a Cloud environment poses important questions for consideration. The answers that emerge from discussing these issues will shape the ultimate Cloud solution that is selected for Turbo FRMAC.

1. A Cloud application means that an Internet connection is required *at all times* to run. Since Turbo FRMAC is an emergency response software, is that an acceptable risk for TF? If you're using software that requires an Internet connection, then you need a reliable, high-speed, broadband Internet connection functioning the whole time you're working. That is often taken for granted in countries such as the United States, but is an issue in developing countries or rural areas where broadband is unavailable. Without an Internet connection — or with a bad one — you are prevented from accessing your data and Cloud-based programs. The same applies if there are any technical issues or outages on the server side.
2. Is a Desktop version of Turbo FRMAC still desired alongside a Cloud version, or will the Desktop version be discontinued in favor of the Cloud? Some Turbo FRMAC users feel that a Desktop version is still needed because an emergency situation could occur where the Internet may not be available or reliable. What are the repercussions if the Desktop version is maintained

alongside a Cloud version? This means that all new features, updates to existing functionality, or bug fixes would need to be implemented twice – once for the Cloud version (online) and once for the Desktop version (offline). The cost of developing the user interface portion of those features would potentially double because of the two independent software applications written for different computing environments. Note that the *AppStream* solution described below enables for *both* Cloud and Desktop versions to be maintained *without* incurring doubled costs described above.

3. Providing software access to international users requires a very manual vetting process. Both LLNL and SNL have similar processes and providing an international user access to Turbo FRMAC currently requires final approval by DOE. Creating a means whereby the vetting efforts by one lab can carry forward to another lab would be ideal. Doing so would require collaboration among the Legal and Licensing departments of all labs involved first before any technological integration across the labs could take place.

Summary of Options

Solution 1: Amazon AppStream

Amazon *AppStream* 2.0 is an application streaming service that allows you to stream desktop applications from AWS to any device running a web browser, without rewriting them as a web application. Traditional desktop applications (like TF) are imported into AWS and then they are streamed to an HTML5-compatible browser (e.g. Firefox, Chrome, etc.) on a variety of devices. Administrators can maintain a single version of each of the apps, which simplifies application management. Users always access the latest versions of the applications and do not download or install any additional software. With *AppStream*, you pay only for the streaming resources that you use, and a small monthly fee per authorized user. There is no upfront investment, and no long-term commitment. With relatively minor modifications, the existing TF application can continue to exist as both a Desktop application *and* as a Cloud application without the duplication of development efforts to support both environments (see *Major Considerations Moving to the Cloud: #2* above).

Solution #2: 100% Web Browser Application

This option requires Turbo FRMAC to evolve into a Web Browser application. This is the direction many software products are moving toward and would allow the widest distribution with the least annual sustainability cost. However, since Turbo FRMAC was not developed initially to be run as a Web Browser application, the current user interface is not compatible with the Web Browser environment. To move in this direction, the user interface elements need to be rebuilt in a Web Browser-compatible software environment, which would require a significant cost for the initial transition. Most of the underlying calculations, data management, and analysis functionality can be transferred to a web environment, but the user interface must be redeveloped.

Redeveloping the Turbo FRMAC user interface into a 100% Web Browser Application would significantly reduce the synergetic relationship it has with other desktop applications developed by the Emergency

Response Software Development Team (ERSDT). The software team that develops TF has created a foundation of reusable code that allows multiple applications with similar functionality to reuse code that has previously been developed by other applications. For example, many of the same UI panels are used in Turbo FFRMAC and in the SHARC software (both are CM applications). Additionally, the Mixture Manager and Radionuclide Viewer tools are used in both Turbo FFRMAC, SHARC, and in other applications such as RASCAL (funded by the Nuclear Regulatory Commission (NRC)). Turbo FFRMAC has been a long-time driver of advancing this foundation of code that benefits many other applications. If Turbo FFRMAC is written as a 100% Web browser application, then the GUI relationship with other software is severed because Turbo FFRMAC would no longer contribute to that code, nor would TF benefit from other contributing application developments. The Radionuclide Viewer and Mixture Manager tools would also require redevelopment as Web Applications; and in the case of these tools, both a Desktop *and* a Web version would have to be maintained (refer to *Major Considerations Moving to the Cloud, #2*) because of other applications like SHARC and RASCAL that need the Desktop versions of these tools.

Cost Analyses

Past proposals were put forth to properly scope the solutions but were not funded. As such, the following cost estimates should be considered high-level estimates only.

- *AppStream* Solution:
 - Research: \$100K to finish planning optional vs. required capabilities
 - Development: \$260K to modify and test TF to ensure it functions effectively in an *AppStream* environment
 - Recurring Costs:
 - \$30K/year for typical expected use.
 - Unknown monthly costs for managing the “fleet” of applications
 - Likely carries the highest continuing cost once implemented
- 100% Web Application Solution:
 - Research: \$100K to research the details of developing a web UI, database requirements, and programming language options
 - Development: \$2-\$3M effort over a 2 to 3-year period to rebuild the TF user interface and supporting tools to use Web-based UI components
 - Recurring Costs: Unknown without additional scoping
 - Carries the highest initial cost of development, but likely lowest recurring cost
- RAMP
 - Recent discussions have considered adding Turbo FFRMAC to the U.S. NRC RAMP program (<https://ramp.nrc-gateway.gov/>), which would offer Turbo FFRMAC as one of the software codes made available to RAMP members. Because members pay a fee for RAMP membership, this could provide a means of recouping the cost of providing a Cloud instance of Turbo FFRMAC.

See Appendix A for additional detail of associated costs.

Recommendation

It is SNL's recommendation to first pursue Amazon *AppStream* (Solution #1) to establish an initial Cloud capability for Turbo FRMAC while the questions described in this report's section, *Major Considerations Moving to the Cloud*, are investigated. The updates to IXP and/or CMweb to navigate users to the Turbo FRMAC Cloud app would also be implemented. The final phase of the user-licensing effort is expected to be completed which contributes to improved user access to TF. If *AppStream* is deemed to be the ultimate solution desired by management and users, then we have a new capability that provides both a Desktop and Cloud version of TF within a short timeframe.

However, if a 100% Web Application is the ultimate solution desired (Solution #2), then *AppStream* can still serve as an interim solution while the full Web Application is under development. Additionally, if the 100% Web application solution continues to utilize the Amazon Cloud platform (as opposed to Windows Azure Cloud) then the same user login and database work (e.g. DCFPAK and user data) developed under the *AppStream* solution can be reused for the Web application as well. It is hopeful that the IXP and CMweb sites would only require minimal changes to redirect users to the 100% Web Application after it is deployed and replaces the *AppStream* version.

What is the benefit?

- 1) Save time spent addressing user install and runtime questions (either for a first-time install or updates to an existing installation). Since we control the online machine and image, then we can guarantee:
 - a) It is properly configured for TF to run optimally and has TF installed properly, saving the time and headache spent troubleshooting user issues regarding installation or updates. With no code to download, then that eliminates installation issues.
 - b) The latest version of TF is deployed to the machine by us -- saving the time spent troubleshooting issues because two individuals have different versions of TF, and guaranteeing updates are applied correctly.
- 2) Optimize TF performance settings. Since we can guarantee the machine's specifications, we can make decisions to optimize TF performance that we normally cannot on others' machines.
- 3) Ease of adoption by others, especially updates by eliminating bureaucratic headaches associated with customers' internal IT restrictions.
- 4) Cloud technology will enable:
 - a) File sharing opportunities once Amazon add-ins are integrated into TF. This would provide Office 365-like sharing.
 - b) Potential for future updates promising the ability to live-share which allows two geographically separated people to work on the same case at the same time.

Appendix A

The following table provides a capability comparison and cost breakdown for the options described above. The dollar amounts are high-level estimates *without* full scoping performed.

	Java Web Start (JWS) (The Current Web Capability)	Amazon AppStream	100% Browser Web Application
Pros	<ul style="list-style-type: none"> • Zero per-user costs • Can run offline if no Internet connectivity is available • If an adequate version of Java is already installed, then no administrative rights are needed. 	<ul style="list-style-type: none"> • Minimal modifications to TF are anticipated • Provides both Desktop and Cloud versions of TF with little additional cost to sustain both • No administrative rights needed 	<ul style="list-style-type: none"> • Allows better future UI optimized for web environments • Better performance on low-speed Internet connections • No administrative rights needed
Cons	<ul style="list-style-type: none"> • Slowest startup time • Requires that the user have a compatible Java client installed. Java clients can be cumbersome to install by users and requires administrative rights 	<ul style="list-style-type: none"> • <i>Optional</i> database development needed (e.g. accessing DCFPAK data) but would provide a better user experience if implemented • <i>Always</i> requires an Internet connection to run TF 	<ul style="list-style-type: none"> • <i>Requires</i> additional database development (e.g. accessing DCFPAK data) • Major redevelopment of the user interface is required • <i>Always</i> requires an Internet connection to run TF • The synergetic relationship with other applications is significantly reduced
Cost	None	<p>\$100K – Research full capabilities of service</p> <p>\$260K – Modifications to Turbo FRMAC and deployment</p> <p>The costs listed above are likely worst-case scenario.</p> <p>Initial deployment within 1 year, with enhancements to follow. Additional funding possibly required for additional collaboration enhancements as desired and database optimization for Cloud environments.</p> <p>\$30K/year recurring cost for typically expected usage</p>	<p>\$100K – Research full capabilities of service</p> <p>\$2-3M – Fully convert Turbo FRMAC to a 100% Web application</p> <p>Completed over a 2 to 3-year effort.</p> <p>Most expensive option for the initial development but per-user costs expected to be lowest</p>

Bibliography

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