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# Zephyrus Introduction

Axios, an LGS Innovations company, supports a number of IC and DoD customers to include the Ground Enterprise Division (GED) of the NRO in the areas of cloud based mission frameworks, cloud infrastructure services, and signal processing applications. This whitepaper will describe a mission prototype called Zephyrus that was developed by Axios under IRAD, and later used in support of our GED Seven Hills program. As a result of our tests, we believe Zephyrus will have a positive cost & performance impact for the NRO if matured under Golden Compass contract.

Zephyrus was developed under internal IRAD to explore cloud agnostic resource allocation, workload load balancing, and cost containment in anticipation of the governments cloud processing initiatives. In addition to greatly simplifying C2S resource provisioning, saving valuable labor hours, Axios also successfully implemented dynamic load balancing to efficiently distribute mission processing loads. Our Zephyrus financial results also show up to 60% cost savings in the C2S environment over legacy mission virtualization frameworks, and up to XX% cost savings over a stock C2S environment.

The Zephyrus solution described in section 3.0 below will walk you through the key features of the tool and how they can be of benefit to the overall NRO mission. If the Zephyrus features and benefits resonate with the Golden Compass program office, Axios proposes taking this IRAD prototype and developing it into an enabling mission application intended for widespread C2S cost savings and use.

# Problem Statement

Cloud Services Providers deliver powerful fee for service capabilities which enable users to easily access computing resources. The complexity required to efficiently utilize those resources however, can inhibit a developer from implementing their project in a straight forward and cost effective manner. AWS’ overly complicated auto-scaling feature for example typically isn’t used because of the complexity in implementing:

* Custom Threshold Metrics
* Service Request Roles
* Launch Configurations
* Auto Scaling Groups
* Alarm Creation
* Policy Creation

More commonly, a developer will statically over provision resources to guarantee functionality.

Zephyrus’ primarily design goal is to abstract and simplify dynamic resource allocation and load balancing by hiding AWS’ inherent complexity. The added benefit of elegantly applying dynamic resource control results in significant AWS cost reductions.

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# The Axios Solution

Taking into account the current shortcomings of the AWS services, Zephyrus’ primarily design goal is to facilitate dynamic resource allocation while hiding its inherent complexity, dynamically “right-sizing” workloads & providing visibility in a cloud agnostic environment. The added benefit of efficiently applying dynamic resourcing is a significant reduction in cost.

## Load Balancing and Resource Provisioning

Zephyrus has the ability to start virtual machines only when needed and terminating them when no longer needed. It offers load balancing and auto-scaling features, but also provides a method for customizing the algorithms if warranted by mission circumstances.

Zephyrus will also allocate a virtual machine to any session that was not able to launch a task due to lack or resources. The VM would be provided by a free agent if available, or newly created. The use of free agents expedite the provisioning process.

Zephyrus monitors the states of all the virtual machine running within the system grouping them by sessions and terminates those that are no longer needed. As mentioned previously, Zephyrus allows full customization of the conditions in which virtual machines are terminated. This continuous monitoring and task orchestration approach is what enables Zephyrus to save provisioning costs while isolating the application from a cloud service specific configuration.

## Resource Visibility

Zephyrus features a web-based visualization application that allows you to monitor the health of the managed applications, and allows you to quickly determine the health of each session using a near teal-time color-coded table. The user can also visualize the health of each virtual machine associated to a session by clicking on the session name.

If the operator is interested in seeing specific tasks then s/he can select a single virtual machine. Zephyrus loads all the information containing the tasks running on the particular virtual machine. Selecting a particular task displays detailed task information such as start time, how long has been running, where is running, et cetera.



Figure 1: Resource Visibility

# The Cost Savings Business Case

With support from our GED Seven Hills program, Axios tested the Zephyrus concept on a multi-user mission application and compared operational costs. We ran two different scenarios and show the cost comparison tables below. The first scenario provides resources for an on-demand number of users during a normal 8 hour shift. The second scenario supports up to sixty users regardless of activity or load.

In both cases we can see a cost saving of almost 50% when the Zephyrus framework manages the cloud resources. The second case shows a “Zephyrus Max Cost”, which is approximately 22% lower that the legacy cost. This is when the framework was instantiated and all the virtual machines required to support sixty users were launched regardless of whether they are actually being used. (This is ambiguous; we need to work on this)

|  |  |  |
| --- | --- | --- |
| **Service** | **Legacy Cost** | **CCDP Cost** |
| EC2 | $9,876.84 | $3,567.25 |
| RDS | $0.00 | $556.32 |
| Total Equiv. Monthly | $9,876.84 | $4,123.57 |

Table 5.2.4-1 Typical usage scenario with variable, unlimited number of users

|  |  |  |  |
| --- | --- | --- | --- |
| **Service** | **Legacy Cost** | **CCDP Typical Cost** | **CCDP Max Cost (\*)** |
| EC2 | $6,449.74 | $3,035.56 | $4,659.24 |
| EBS | $515.29 | $403.37 | $403.37 |
| RDS | $0.00 | $365.38 | $365.38 |
| Total Monthly | $6,965.03 | $3,804.31 | $5,427.99 |

(\*) Running all necessary instances 100% of the time due to support requirements

Table 5.2.4-2 Sixty users on eight hours shift monthly cost comparison

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | Service | AWS Cost | AWS Cost | Zephyrus/AWS Cost | Zephyrus/AWS Cost | | Scenario | Typical Variable Usage up to 100 users | Sixty users on eight hours shift | Typical Variable Usage up to 100 users | Sixty users on eight hours shift | |  |  |  |  |  | | ECS | $9,876.84 | $6,449.74 | $3,567.25 | $3,035.56 | | EBS |  | $515.29 |  | $403.37 | | RDS | $0.00 | $0.00 | $556.32 | $365.38 | | Other costs | $0.00 | $0.00 | $0.00 | $0.00 | | Monthly Total | $9,876.84 | $6,965.03 | $4,123.57 | $3,804.31 | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Service | AWS Cost | Zephyrus/AWS Cost | AWS Cost | Zephyrus/AWS Cost |
| Scenario | Typical Variable Usage up to 100 users | Typical Variable Usage up to 100 users | Sixty users on eight hours shift | Sixty users on eight hours shift |
|  |  |  |  |  |
| ECS | $9,876.84 | $3,567.25 | $6,449.74 | $3,035.56 |
| EBS |  |  | $515.29 | $403.37 |
| RDS | $0.00 | $556.32 | $0.00 | $365.38 |
| Other costs | $0.00 | $0.00 | $0.00 | $0.00 |
| Monthly Total | $9,876.84 | $4,123.57 | $6,965.03 | $3,804.31 |