Apples and Oranges
An experience in using cloud Cost Calculators and Rate Cards

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Outline

- Motivation and Approach
- Our Application Questionnaire
- Calculators and Tools Considered
- Cost Estimate Comparison
- Comparing Apples and Oranges
- Lessons Learned
- Next Steps
Motivation and Approach

- **Team tasked with achieving DoD sponsor’s objectives:**
  - Instantiate an on-premises, contractor-owned, contractor-operated (COCO) cloud pilot
  - Better understand cloud cost, schedule, and performance implications

- **Assessed reasonableness of sponsor Independent Government Cost Estimate (IGCE) by comparing to available cost estimate benchmarks:**
  - Team input candidate systems’ data into over a dozen calculators and rate cards for estimating storage and hosting costs for cloud applications

- **Evaluated relationship between application complexity and cloud cost:**
  - Developed an Application Complexity Plotter to visualize complexity

- **Began developing a parameterized cloud cost model that could support Total Ownership Cost (TOC) assessment, Return-on-Investment (ROI) analysis, and “what if” scenario-building**
Our Application Questionnaire

To select, prioritize, and plan

- App Type
  - User Locations
  - Accreditation
- Impact Level
  - Criticality
  - NIPR/SIPR
- User Types
  - # of Users
  - Demand Volatility
- Virtualization
- Operating System
- Load Balancers
- Type and Number
- Hard Coding
- Licensing
- Cores
- Server Types/Qty
- RAM
- System Utilization
- Network Utilization
- Method
  - Connection Speed
  - Peak Rate
- App Storage
- DB Storage
- Logs Allocation
- App Type
- User Locations
- Accreditation
- Impact Level
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- System Utilization
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- Method
  - Connection Speed
  - Peak Rate
- App Storage
- DB Storage
- Logs Allocation
- Security
- Risk
- Quality
- Other complexity considerations
- Refactoring Risks
- Migration Risks
- Documentation Quality
- Encryption
- Identity Mgmt
- Authentication
- Requirements
- Backup Size
- Svc Continuity
- Backup
- Storage
- Transmission
- Utilization
- Workload
- Architecture
- Dependencies
- Size
- Complexity?
Candidate Application Data

- Received a wide variety of data on ~30 systems from multiple commands and CONUS geographies, complexities (low-high)
- Key usable inputs across the various calculators were number of cores*, required memory/RAM, and required storage

<table>
<thead>
<tr>
<th>App Name</th>
<th># cores: Web/App</th>
<th># cores: DB</th>
<th>TOTAL # cores</th>
<th>Req. RAM: Web/App</th>
<th>Req. RAM: DB</th>
<th>TOTAL Req. RAM</th>
<th>Storage: Web/App</th>
<th>Storage: DB</th>
<th>TOTAL storage GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>System 1</td>
<td>10</td>
<td>6</td>
<td>16</td>
<td>40 GB</td>
<td>48 GB</td>
<td>88 GB</td>
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<td>4</td>
<td>6</td>
<td>8 GB</td>
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<td>2507 GB</td>
<td>2687 GB</td>
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<tr>
<td>System 3</td>
<td>272</td>
<td>0</td>
<td>272</td>
<td>1072 GB</td>
<td>0</td>
<td>1072 GB</td>
<td>31758 GB</td>
<td>0 GB</td>
<td>31758 GB</td>
</tr>
<tr>
<td>System 4</td>
<td>18</td>
<td>6</td>
<td>24</td>
<td>61 GB</td>
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<td>90 GB</td>
<td>1160 GB</td>
<td>3000 GB</td>
<td>4160 GB</td>
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<td>System 5</td>
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<td>40</td>
<td>168</td>
<td>264 GB</td>
<td>224 GB</td>
<td>488 GB</td>
<td>11202 GB</td>
<td>17000 GB</td>
<td>28202 GB</td>
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<tr>
<td>System 6</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>4 GB</td>
<td>0</td>
<td>4 GB</td>
<td>730 GB</td>
<td>0 GB</td>
<td>730 GB</td>
</tr>
</tbody>
</table>

A core is the central processing unit (CPU) that executes sequential instructions. A single silicon chip can have as many as 22 cores. A core is the basic computation unit of the CPU.
Status Quo O&S Cost for Some Apps

- Received one year of status quo operations cost for 23 systems

Collection of status quo apps ops costs provided insight into costs, but lacked fidelity
Early Analysis: Number of Cores as a Predictor of Memory & Storage Cost

Circle color corresponds to memory as a multiple of # cores
(Green=small; gold=medium; purple=large)

Circle size corresponds to storage as a multiple of # cores

Blue line is the cost line by core using the standard 2 x GB memory and typical storage
Calculators and Tools Considered

- **Online calculators:**
  - FEDRAMP GovCloud Shopper
  - Cloud.gov
  - Microsoft Azure online calculator
  - Amazon Web services online calculator
  - Google Web services calculator
  - Cloudorado

- **Rate cards/Spreadsheet calculators:**
  - DISA MilCloud Rate Card
  - DOD Rate Card Estimator (draft)
  - Navy Cloud Store (AWS)
  - LOGSA Rate Card
  - GSA IAAS Estimator
  - Cloud Cost Lite-MITRE developed tool
  - Technology Insertion Model (MITRE-developed tool with migration component)
  - DOD CIO Cloud Calculator (in development)

- **Individual vendor rates**

- **Commercial Parametric Models**
Rate Cards…User Beware!

- Rate cards should be taken with a grain of the proverbial salt
- IT Shops sometimes provide "rate cards" or catalogs that provide costs for various services.
- Unfortunately, frequently little to no context is provided, And there may be little insight as to how inputs are applied ("blackbox"). Excel-based calculators were more transparent, but insight was still lacking.
- For example, the DISA Rate Card is a single pdf spreadsheet listing prices for various services, with very little explanation
- Some sort of estimating methodology has to be assumed/created, as well as a discussion with the maker of the rate card to get context
Cost Estimate Comparison

We compared the sponsor’s IGCE to 17 calculator estimates

Hosting Costs for 34 Apps for Current Year
Estimates from Available Rate Cards and Tools

The Independent Government Cost Estimate (IGCE) is 81% less than the Status Quo ($20M) and is 3% less than the average of other comparative benchmarks.

Compare the IGCE (excluding integration) cost of $3,770,704 to the average of the estimates that are definitely not off-premises, public, or PaaS = $3,879,492.

IGCE estimate excluding integration cost = $3.8M
Cost Estimate Comparison

To assess the reasonableness of an IGCE, developed ROM estimates using available tools, calculators, and rate cards from Government, DoD, and commercial industry.

The current legacy status quo estimate is approximately $20M/year for 34 apps. In a Cloud environment, all comparison benchmarks are less than $10M/year, representing more than a 50% reduction in expected cost.

The second stacked bar from the left represents the IGCE. $3.8M per year to host 34 apps compares reasonably with other benchmarks.
Comparing Apples and Oranges

- The cloud achieves efficiencies through **standardization**, shared resources and commoditization.

  Items may be bundled differently by vendor and by model.

- Many vendors include or leave out items that do not vary in their standard offerings:
  - Security Level
  - Connectivity
  - Utilization Allowance *(elastic, reserved)*
  - IaaS, PaaS, SaaS

- Most vendors will offer a custom quote for non-standard items.

- Apples and Oranges can still be compared. They must first be normalized as much as possible.
## Calculator/Tool Inputs

### Partial Universe of Cost Calculator/Rate Card Inputs

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td># of User Accounts</td>
<td>10</td>
<td>Req. RAM: DB</td>
<td>19</td>
</tr>
<tr>
<td>2</td>
<td># Concurrent Users</td>
<td>11</td>
<td># cores: Web/ App</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Types of Servers</td>
<td>12</td>
<td># cores: DB</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td># of each type of server</td>
<td>13</td>
<td>Req. RAM: Web/App</td>
<td>22</td>
</tr>
<tr>
<td>5</td>
<td>Data size in GB</td>
<td>14</td>
<td>Hard Drive Space Needed</td>
<td>23</td>
</tr>
<tr>
<td>6</td>
<td>Logs allocation</td>
<td>15</td>
<td>CPU Power</td>
<td>24</td>
</tr>
<tr>
<td>7</td>
<td>Current system utilization rate</td>
<td>16</td>
<td>Web app instances</td>
<td>25</td>
</tr>
<tr>
<td>8</td>
<td>Current network utilization</td>
<td>17</td>
<td>DB instances</td>
<td>26</td>
</tr>
<tr>
<td>9</td>
<td>WAN bandwidth for currently traversed circuits</td>
<td>18</td>
<td>Instance Type</td>
<td>27</td>
</tr>
<tr>
<td>28</td>
<td>PUT requests</td>
<td>29</td>
<td>OS</td>
<td>30</td>
</tr>
<tr>
<td>31</td>
<td>Elastic Block Store (EBS) Opt</td>
<td>32</td>
<td># Elastic Load Balancers</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>total hrs per month</td>
<td>34</td>
<td>VM class</td>
<td>35</td>
</tr>
<tr>
<td>36</td>
<td>Available local Solid State Drive (SSD) space</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Of these, here are the inputs that appear to matter the most

- **Almost all** models ask about:
  - **Compute**
  - **Memory**
  - **Storage**

- **The majority of** models ask about:
  - **Transmission**
  - **Labor inducing factors (like # of VMs, PaaS)**
  - **Utilization**
  - **Operating System (i.e. Windows, Linux)**

- **Occasionally** models/rate cards prompt questions on:
  - **Software & Server Types**
  - **Value added offerings** e.g.,
    - Architecture
    - Monitoring
    - Security

**Inputs that Typically Drive Costs are shown by red ovals**
Lessons Learned about Calculators, Rate cards, and Cloud Cost Tools

- Most models only calculate annual recurring costs, with no allowance for storage and compute growth year-over-year.
- Models do not estimate other major cost elements such as: system engineering and program management; integration and test; security-related costs; professional/managed services, migration costs.
- Some tools include an option to estimate Disaster Recovery, COOP, and some additional professional services.
- On versus off-premise considerations were not inputs to most calculators.
- Private vs. public considerations were not inputs to most calculators.
- Few tools include cost for uncertainty/risk.
- Some models do not use cloud impact level (DOD-specific term) but instead use Federal Information Security Management Act (FISMA); others had no security variable.
Next Steps: Parameterized Lifecycle Model for Cloud

**MODEL INPUT**

- **Cloud Hosting Options**
  - Deployment Models:
    - IaaS
    - PaaS
    - SaaS
  - Service Models:
    - Private
    - Community
    - Public

- **Hosting Requirements**
  - Current Cost
    - Basis of Estimate
    - GR&A
  - Functional Drivers of Cloud Cost
    - Objective
    - Subjective

**MODEL TRANSFORM**

- Application Complexity Plotter (Next slide)

**MODEL OUTPUT**

- Insourced vs Outsourced:
  - Storage $
  - Compute $
  - Transmit $
  - Managed Service $
  - Other – Optional

- Reporting
- CBA
  - LCCE
  - IGCE
- Pay per Use
- What-If Calculator
Next Steps: Application Complexity as an Indicator of Cloud Cost Impact
Backup
NIST Cloud Definition

Deployment Models
- Private Cloud
- Community Cloud
- Public Cloud
- Hybrid Clouds

Service Models
- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)
- Software as a Service (SaaS)

Essential Characteristics
- On Demand Self-Service
  - Broad Network Access
  - Resource Pooling
  - Rapid Elasticity
  - Measured Service
- Resilient Computing
- Geographic Distribution
- Service Orientation
- Advanced Security

Common Characteristics
- Massive Scale
- Homogeneity
- Virtualization
- Low Cost Software
NIST Cloud Services

Public Sector Management of XaaS Platforms

Traditional IT
- Applications
- Data
- Runtime
- Middleware
- Operating System
- Virtualization
- Servers
- Storage
- Networking

Infrastructure (as a Service)
- Applications
- Data
- Runtime
- Middleware
- Operating System
- Virtualization
- Servers
- Storage
- Networking

Platform (as a Service)
- Applications
- Data
- Runtime
- Middleware
- Operating System
- Virtualization
- Servers
- Storage
- Networking

Software (as a Service)
- Applications
- Data
- Runtime
- Middleware
- Operating System
- Virtualization
- Servers
- Storage
- Networking

Source: Adapted from IDC Government Insights
Lessons Learned about our Analysis

- **It’s a pilot—we will learn from it!**
  For this project, we had to remind ourselves that the reason our customer was conducting a pilot in the first place was because we did not have all the answers—including what it would cost.

- **Inform the customer to manage expectations.**
  In our customer’s case, they were going to a private, on-premises cloud; much of the cost savings associated with the public cloud (due to amortized costs over multiple customers) would not be realized.
  - Note cost differences (e.g., high upfront costs, less realized savings) as well as benefits (e.g., higher security)

- **No formal survey existed** that we could find comparing multiple calculators, though several had examined AWS & DISA.

- **Use an RFI as a tool to gather information directly from vendors**

- **Access to cloud subject matter experts** key
Google Cloud Calculator

Google Cloud Platform Pricing Calculator

<table>
<thead>
<tr>
<th>Google Cloud Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard storage</td>
</tr>
<tr>
<td>Durable Reduced Availability storage</td>
</tr>
<tr>
<td>Cloud Storage Nearline</td>
</tr>
</tbody>
</table>

Compute Engine
- Region: US
- VM class: regular
- Instance type: n1-standard-2
- Cores per instance: 2
- RAM per instance: 7.5 GB
- Paid OS Cost (Windows): $32,236.80
- GCE Instance Cost: $28,207.20
- total hrs per month: 402,960 hrs/mo
- price per instance: $0.28/hr
- monthly price: $208.00/mo
- Total available local SSD space: 1x375 GB
- Sustained use discount: 30%
- effective hourly rate: $0.26/hr
- Estimated monthly cost: $105,777.00/mo

Persistent Disk (Storage)
- storage: 288,870 GB
- Estimated monthly cost: $11,554.80

Load Balancing (global)
- Forwarding rules: 68
- Network ingress/egress: 3200 GB
- Estimated monthly cost: $503.75

Network Bandwidth
- Egress to different zone in same region: 100 GB
- Estimated monthly cost: $2.00
- Total Estimated Monthly Cost: $117,837.55/mo

Total Estimated Annual Cost: $1,414,050.60/yr
Clouderado Pricing Tool—the “Kelly Blue Book” of Clouds

- **Key Inputs:**
  - VM Size, Qty, Storage (Doubling storage doubles $)
  - FISMA low/moderate only.
  - Backup/storage computed together.
  - Provides low-average high range
  - Also provides prices for utility cloud services
  - Considers 19 vendors

<table>
<thead>
<tr>
<th>Cloud Provider</th>
<th>Cloud Server Summary</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google</td>
<td>f1-micro</td>
<td>$7</td>
</tr>
<tr>
<td>Windows Azure</td>
<td>Basic A0</td>
<td>$15</td>
</tr>
<tr>
<td>ZIPPY CLOUD</td>
<td>1 GB RAM / 1x VCPU SSD Instance</td>
<td>$15</td>
</tr>
<tr>
<td>M5</td>
<td>M5 Small (2 GB RAM, 1 VCPU)</td>
<td>$15</td>
</tr>
<tr>
<td>CloudSigma</td>
<td>SSD 512 MB RAM / 1x 0.5 GHz VCPUs</td>
<td>$19</td>
</tr>
<tr>
<td>atlantic.net</td>
<td>SSD 2.0 GB RAM / 1x 2.4 GHz VCPUs (M Server)</td>
<td>$19</td>
</tr>
<tr>
<td>OPENHOSTING</td>
<td>SSD 512 MB RAM / 1x 0.5 GHz VCPUs Linux Container</td>
<td>$20</td>
</tr>
</tbody>
</table>

**RAM:**
- 512, 768, 1G, 1.5G, 2G, 4G

**Storage:**
- 1GB, 2, 5, 10, 20, 50

**CPU Power:**
- eq. Xeon E5520

**OS:**
- Linux
- Windows