Background

The TIMES Cloud Service & The TIMES/MIRO app are currently running ETSAP R&D undertakings (see proposal from Winter 2020 Workshop on YouTube)
Agenda

• TIMES Cloud Service
  • Motivation
  • Status report
  • Outlook

• TIMES/MIRO App
  • Motivation
  • Status report
  • Live demo
TIMES Cloud Service - Motivation

We have been asked for a solution allowing

• occasional/new TIMES users to solve TIMES models
  • without the need to purchase a GAMS/Solver license
  • without limitations imposed by free services such as NEOS
    (academic use only, resource restrictions)

• existing TIMES users to outsource certain computations to powerful hardware

→ Submitted a project proposal for a TIMES Cloud Service in 12/2020

• that allows to solves TIMES models “in the cloud”, license centrally administered by ETSAP

• that is convenient to access (various clients)

• that uses state-of-the-art cloud technology (GAMS Engine)
TIMES Cloud Service - Status Report

04/01/2021                         today                             03/31/2023

Q1  Q2  Q3  Q4  Q5  Q6  Q7  Q8

- TIMES Cloud Service BETA is up and running (communication SSL encrypted)
- The Service runs on a dedicated server (12 cores, 128 GB RAM)
- Up to 8 parallel Jobs allowed (resources are shared)
- The Service supports git Continuous Integration (CI)
  - For More details see GAMS Blog and examples on GitHub:
    - https://github.com/GAMS-dev/actions
    - https://github.com/GAMS-dev/TIMES_Demo
- Request access by sending an email to timescloud@etsap.org
- Statistics:

<table>
<thead>
<tr>
<th></th>
<th>2,740 (2376 from Veda Online)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#jobs:</td>
<td>2,740</td>
</tr>
<tr>
<td>#crashes:</td>
<td>0</td>
</tr>
<tr>
<td>total solve time:</td>
<td>63 hours, 35 minutes, 23 seconds</td>
</tr>
<tr>
<td>#real user (not part of the project team):</td>
<td>3</td>
</tr>
</tbody>
</table>

😊🤔
Outlook: How to make the TIMES/Cloud Service more attractive?

One potential approach: Dedicated server $\rightarrow$ Elastic Cloud

**Current Solution: Dedicated Server**

(aka GAMS EngineONE)

- Models registered by Admins
  - TIMES Version 4.5.9
  - TIMES Version 4.5.8
  - ...

- Single dedicated server
  - (12 cores / 128 GB RAM)
  - running 24/7

- Parallel workers (sharing resources)
Outlook: How to make the TIMES/Cloud Service more attractive?

One potential approach: Dedicated server → Elastic Cloud

Future Solution: Elastic Cloud?
(aka GAMS Engine SaaS)

A broad set of AWS Cloud instances available.
→ Get proper resources for any TIMES model

parallel workers on on-demand instances (not sharing resources!)
Outlook: How to make the TIMES/Cloud Service more attractive?

One potential approach: Dedicated server → Elastic Cloud

- Both approaches have upsides and downsides

<table>
<thead>
<tr>
<th>Dedicated Server</th>
<th>Elastic Cloud</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resources shared among parallel jobs → This is limiting parallel capabilities</td>
<td>Resources exclusive to job → (almost) unlimited horizontal scaling</td>
</tr>
<tr>
<td>Max resources limited by server (12 cores / 128GB RAM)</td>
<td>Technically (almost) no resource limitation (many TB RAM) → user quotas required</td>
</tr>
<tr>
<td>No startup time</td>
<td>~2 minutes startup time</td>
</tr>
<tr>
<td>Commercially simple</td>
<td>Commercially (a bit more) complex</td>
</tr>
<tr>
<td>• Machine based licensing</td>
<td>• AWS instances with hourly rates</td>
</tr>
<tr>
<td>• Single server available 8760 hours/year</td>
<td>• Annual compute time budget (scales with hourly instance price)</td>
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<table>
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<tr>
<th>AWS Instance</th>
<th>vCPU</th>
<th>Memory (GB)</th>
<th>Scaling factor</th>
<th>Compute hours p.a.</th>
</tr>
</thead>
<tbody>
<tr>
<td>z1d.large (default)</td>
<td>2</td>
<td>16</td>
<td>1</td>
<td>3000</td>
</tr>
<tr>
<td>z1d.xlarge</td>
<td>4</td>
<td>32</td>
<td>1.03</td>
<td>2919</td>
</tr>
<tr>
<td>z1d.2xlarge</td>
<td>8</td>
<td>64</td>
<td>1.08</td>
<td>2769</td>
</tr>
<tr>
<td>z1d.3xlarge</td>
<td>12</td>
<td>96</td>
<td>1.14</td>
<td>2634</td>
</tr>
<tr>
<td>z1d.6xlarge</td>
<td>24</td>
<td>192</td>
<td>2.22</td>
<td>1351</td>
</tr>
<tr>
<td>x1e.4xlarge</td>
<td>16</td>
<td>488</td>
<td>2.50</td>
<td>1200</td>
</tr>
<tr>
<td>x1e.8xlarge</td>
<td>32</td>
<td>976</td>
<td>4.33</td>
<td>692</td>
</tr>
<tr>
<td>x1e.16xlarge</td>
<td>64</td>
<td>1952</td>
<td>10.98</td>
<td>273</td>
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To summarize...

Simplicity vs. Flexibility
MIRO Desktop
Everything local

- GAMS & MIRO installed locally
- Synchronous job execution

NEOS
MIRO APP only

GAMS Studio

Other APIs (Python, Java, etc.)

MIRO Desktop
Boosted by GAMS Engine

- MIRO installed locally
- Synchronous and asynchronous job execution

TIMES
Cloud Service

MIRO Server
Everything on a server
→ No software installed locally

both

Cloud Service Only

Web User Interface

Cloud Service Only

GAMS & MIRO installed locally

Synchronous job execution

• MIRO application

• MIRO Server

• MIRO Desktop

• Boosted by GAMS Engine

• Everything local

• Everything on a server

• MIRO Desktop

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TIMES
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pt. 2

MIRO Server
Everything on a server
→ No software installed locally

pt. 1

Both

MIRO application

Cloud Service Only

Web User Interface

GAMS Studio

Other APIs (Python, Java, etc.)

Veda

Cloud Service Only
Background & Motivation:

- TIMES source code published under an open-source license in Dec 2019
- Deployment Framework GAMS MIRO published under an open-source license in Apr 2020
- Open Modelling Trend
  - Many Energy Models are published open-source (such as TIMES)
  - Certain models rely on GUIs - no open-source TIMES GUI available so far
- (Potential) TIMES users that operate on a tight budget...
  - ... have a need for a low-cost/free GUI to their TIMES Model
  - ... have a need for a low-cost/free GAMS/Solver licensing option
- Dissemination of a TIMES model (e.g. to allow others to reproduce results)
The TIMES/MIRO App...

• ... has received a major overhaul and provides new features
• ... is open-source and published on Github
• ... is fully integrated with the TIMES Cloud Service and accessible online (request access by sending an email to timescloud@etsap.org)
What is GAMS MIRO?
A Deployment framework to turn GAMS models into interactive (web) applications

- Annotation of existing GAMS model to define GAMS Symbols shown in the interface
- Configuration mode with a broad set of predefined charts, maps, widgets, etc.
- Support for custom renderers
- Comes with a database to save/load scenarios
- Scenario comparison mode
- Deployment of MIRO App in a single self contained *.miroapp file
- Gateway for optimizing in the cloud (read more)
The TIMES/MIRO App
Basic Functionality

How to run TIMES

TIMES Driver (the *.RUN file)

```plaintext
>Title TIMES -- VERSION 4.5.9
option resLim=1000, [...], bRatio=1;
option [...], solver=cplex;
$offListing
[...]
$set OBJ MOD
$set BOTIME 1970
[...]
$batInclude initsys.mod
$batInclude initmty.mod
$batInclude base.dd
$batInclude nt-agr.dd
$batInclude nt-com.dd
[...]
$batInclude maindrv.mod mod
```

TIMES Source

- 244 files
- 22,647 lines
- Not touched!

[...]
initmty.mod
initsys.mod
maindrv.mod
[...]

TIMES Data

- *.dd files
  - base.dd
  - nt-agr.dd
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Browsing/editing data cube in powerful pivot tables

The TIMES/MIRO App acts like a wrapper that creates TIMES Data and the TIMES Driver.
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TIMES Data

Run configuration via user friendly widgets

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The TIMES/MIRO App acts like a wrapper that creates TIMES Data and the TIMES Driver

Browsing/editing data cube in powerful pivot tables

Run configuration via user friendly widgets

“Solve model”:
• App writes *.dd files
• App writes the driver
• App runs/submits job

How to run TIMES

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The TIMES/MIRO App
Basic Functionality

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Run configuration via user friendly widgets

Create charts, e.g. to compare scenarios
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The TIMES/MIRO App acts like a wrapper that creates TIMES Data and the TIMES Driver

Browsing/editing data cube in powerful pivot tables
Run configuration via user friendly widgets
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RES Viewer
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Create charts, e.g. to compare scenarios

RES Viewer

- Enabling/Disabling TIMES extensions
- Asynchronous runs (submit job now, collect results later)
- 3 Scenario comparison modes
- Access to GAMS output (.log and .lst)
- Comes with publicly available datasets (TIMES_Demo/TIMES-DK_COMETS)
- Supports import of any other TIMES data set (*.dd files and *.run file required)
- Can be used online (with TIMES Cloud Service backend) or offline

And much more…
Enjoy the Demo by Dr. Evangelos Panos
Thank You!

Request access to the TIMES Cloud service (includes access to the online TIMES/MIRO app): timescloud@etsap.org
TIMES Cloud Service user manual: https://cloud.gams.com/s/9FtqfzqCQorodDs
TIMES Cloud Service web UI: https://times.gams.com/engine/
TIMES/MIRO web application: https://times.gams.com/login
TIMES/MIRO on GitHub: https://github.com/GAMS-dev/TIMES_MIRO
Ask questions / Provide feedback: ffiand@gams.com