



# The TIMES Cloud Service

Webinar  
20th May 2022  
Open Energy System Modelling

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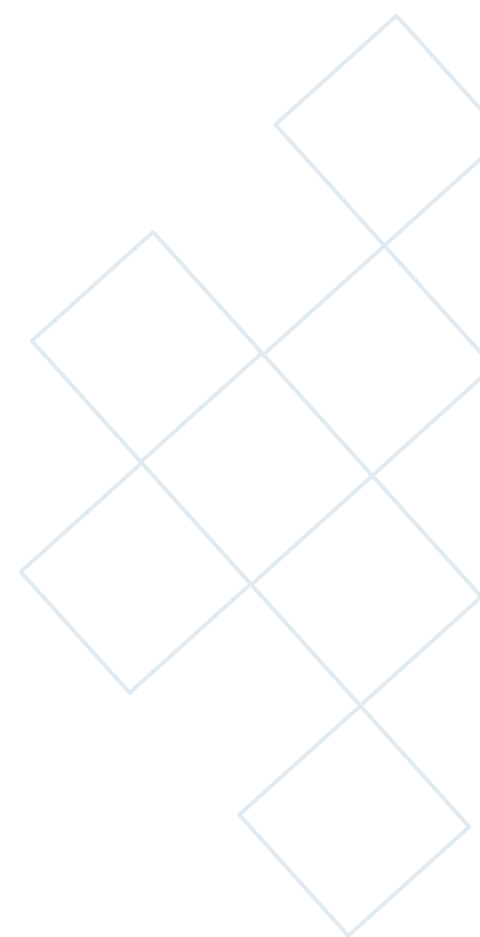
# GAMS

Who are we?

What do we offer?

Why are we here?

Increasing Openness through the TIMES Cloud Service!



# GAMS Who are we?



## History

- **General Algebraic Modeling System**
- Roots: World Bank, 1976
- Went commercial in 1987
- Locations: USA, Germany

## Our Competencies & Activities

- Software system to model and solve optimization problems
- **First** algebraic modeling software
- **Customer support** for our software and all bundled solver products
- **Technical Consulting** services
- **Projects** with extensive partner network

## Our Customers

- **Worldwide** installations
- Academic and commercial
- Energy, economics, logistics, operations research, and many more
- Big and small companies, government agencies

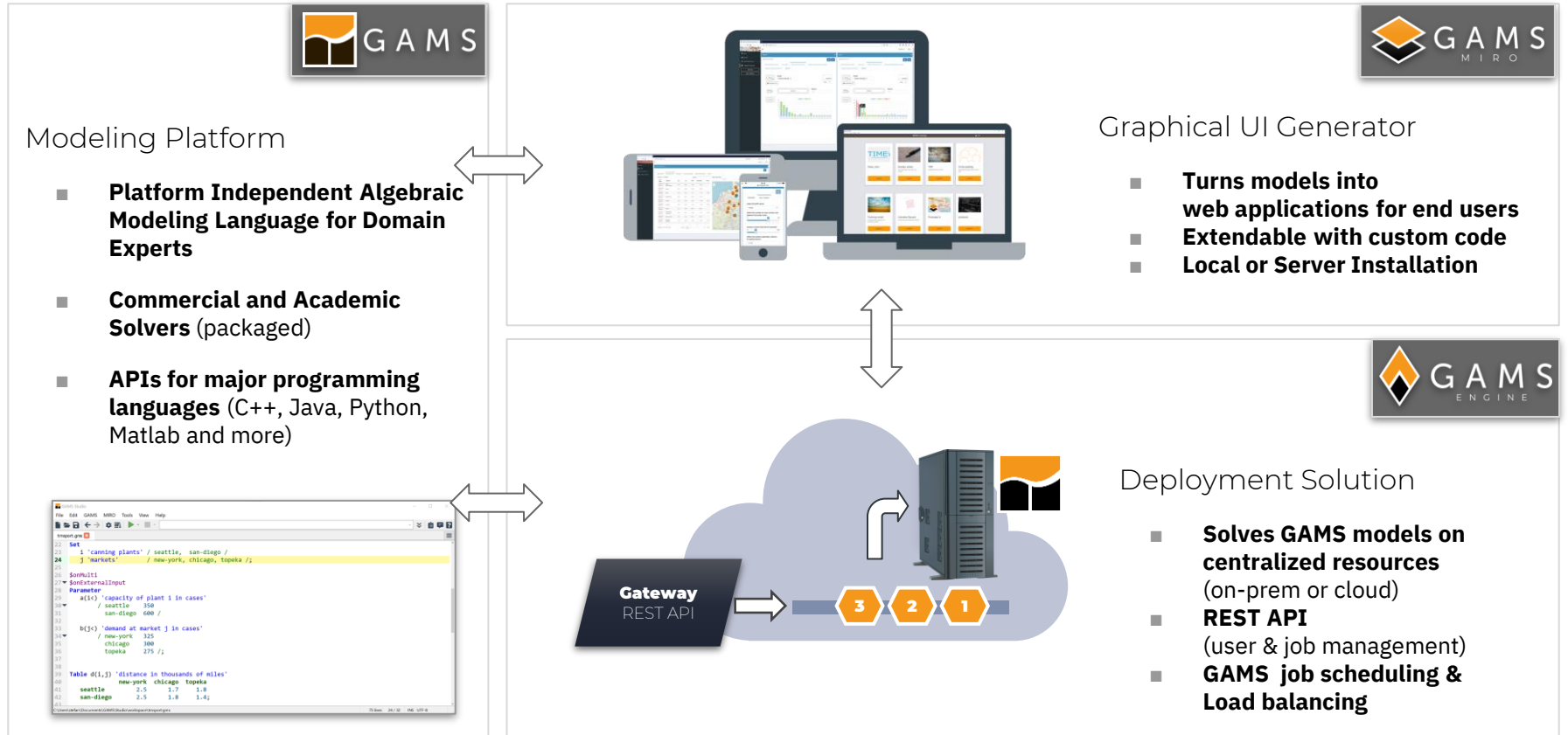


## Our Staff

- 29 full time + students (US & EU)
- PhD level modeling and optimization experts with startup mentality
- Experienced management, generational change in 2015



# GAMS What do we offer?



# GAMS Why are we here?



## Broad range of application areas

Agricultural Economics	Applied General Equilibrium
Chemical Engineering	Economic Development
Econometrics	Energy
Environmental Economics	Engineering
Finance	Forestry
International Trade	Logistics
Macro Economics	Military
Management Science/OR	Mathematics
Micro Economics	Physics

# GAMS Why are we here?



openmod Search

Navigation  
Main page  
Models  
Model implementations

Page Discussion

## Open Models

This page lists energy models published under open source licenses. We regard licenses approved by OSI ([opensource.org](https://opensource.org)) and The Open Definition ([opendefinition.org](https://opendefinition.org)) as suitable for open source models and open data respectively. Please contact us if you

Overview of models by type, software, implementation and processing

Model	Model class	Modelling software	Processing software
<a href="#">Balmorel</a>	GAMS	GAMS	
<a href="#">EOLES elec</a>	Electricity System Model	GAMS	
<a href="#">EOLES elecRES</a>	Electricity System Model	GAMS	
<a href="#">Medea</a>	Austrian and German electricity market	GAMS	Python
<a href="#">ELMOD</a>	German and European Electricity Market	GAMS	
<a href="#">EMMA</a>	Power market model	GAMS	
<a href="#">STELMOD</a>	Optimization	GAMS	MS Excel
<a href="#">TIMES</a>	Local National Regional Global models developed using TIMES	GAMS	EXCEL, VEDA, ANSWER

13 models listed on openmod are implemented in GAMS.

Source: [https://wiki.openmod-initiative.org/wiki/Open\\_Models](https://wiki.openmod-initiative.org/wiki/Open_Models)



2020

- TIMES source code published on GitHub under an open source license
- GAMS license required
- Solver license required
- VEDA license required (front-end to TIMES)

Challenge: Increase the openness of the TIMES toolbox such that ...

- ... the entry barrier for new users is lowered
- ... occasional users do not need to worry about licensing
- ... the dissemination of models/results becomes license independent



# TIMES Cloud Service / TIMES MIRO APP Proposals

→ Submitted joint ETSAP R&D project proposals in 12/2020

## The TIMES Cloud Service

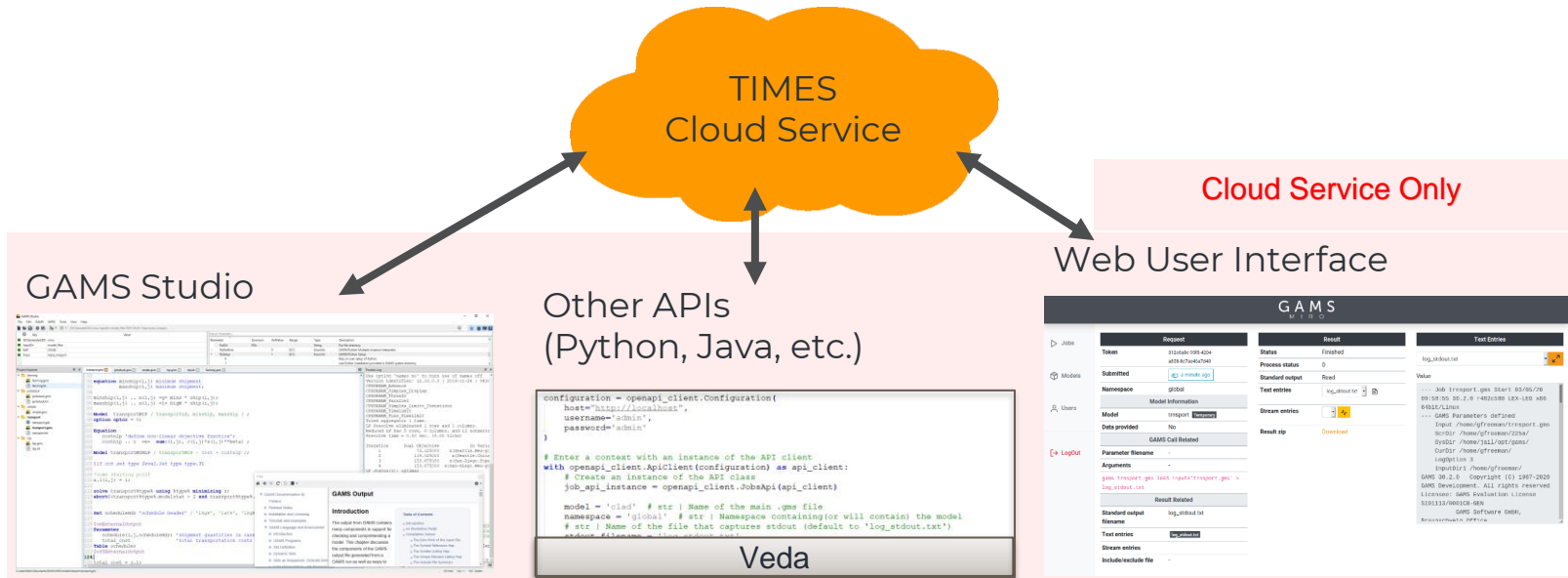
- allows to solve TIMES models “in the cloud”, license centrally administered by ETSAP
- is convenient to access (username/password, various clients)
- builds on state-of-the-art cloud technology (GAMS Engine)

## The TIMES MIRO APP

- is a free to use open source front end to TIMES
- builds on the (open source) graphical UI Generator GAMS MIRO

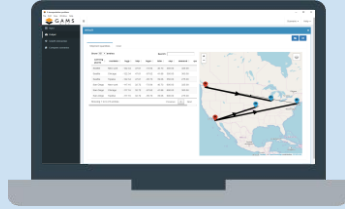
→ Both projects unfold synergies





# MIRO Desktop

Everything local



- GAMS & MIRO installed locally
- Synchronous job execution

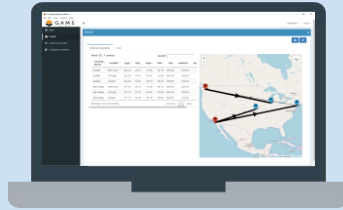
**MIRO APP only**





# MIRO Desktop

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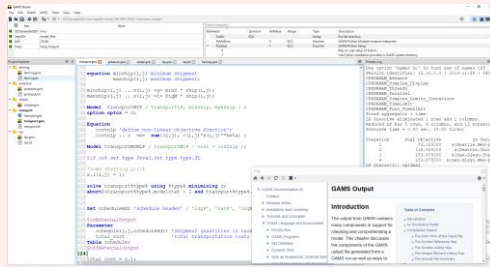
MIRO APP only

## TIMES Cloud Service

Cloud Service Only

Web User Interface

GAMS Studio



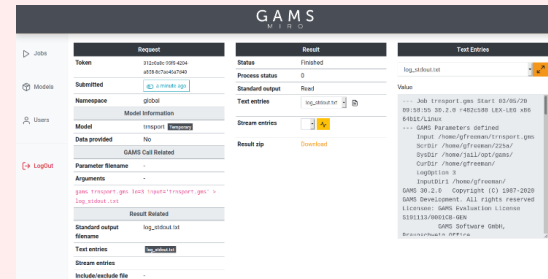
Other APIs  
(Python, Java, etc.)

```
configuration = openapi_client.Configuration(
    host="http://localhost",
    username="admin",
    password="admin"
)

# Enter a context with an instance of the API client
with openapi_client.ApiClient(configuration) as api_client:
    # Create an instance of the API class
    job_api_instance = openapi_client.JobsApi(api_client)

    model = 'load' # str | Name of the main .gms file
    namespace = 'global' # str | Namespace containing(or will contain) the model
    # str | Name of the file that captures stdout (default to 'log_stdout.txt')
    stdout_filename = 'log_stdout.txt'
```

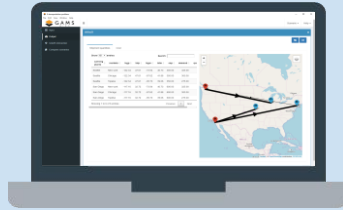
Veda





## MIRO Desktop

Everything local

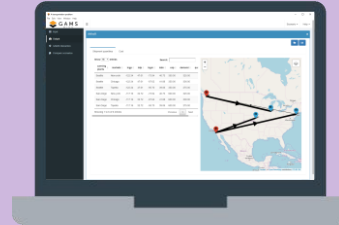


- GAMS & MIRO installed locally
- Synchronous job execution

MIRO APP only

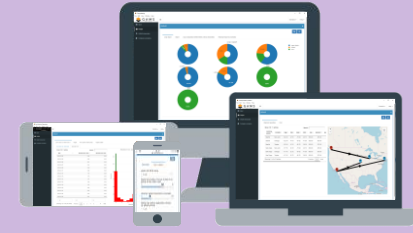
## MIRO Desktop

Boosted by  
GAMS Engine



- MIRO installed locally
- Synchronous and asynchronous job execution

MIRO Server  
Everything on a server  
→ No software installed locally



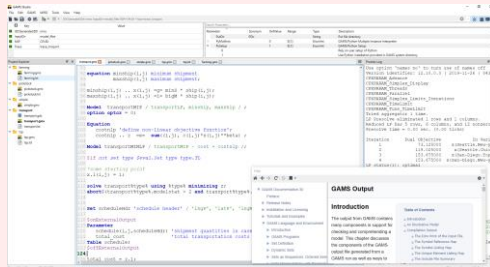
MIRO application

Both

TIMES  
Cloud Service

Cloud Service Only

## GAMS Studio



Other APIs  
(Python, Java, etc.)

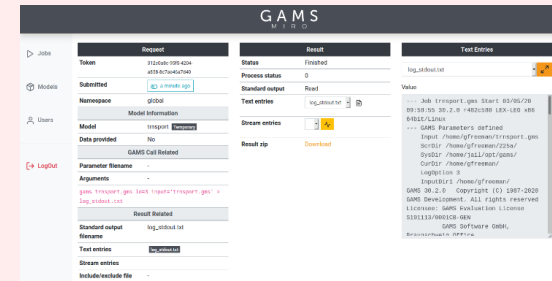
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```

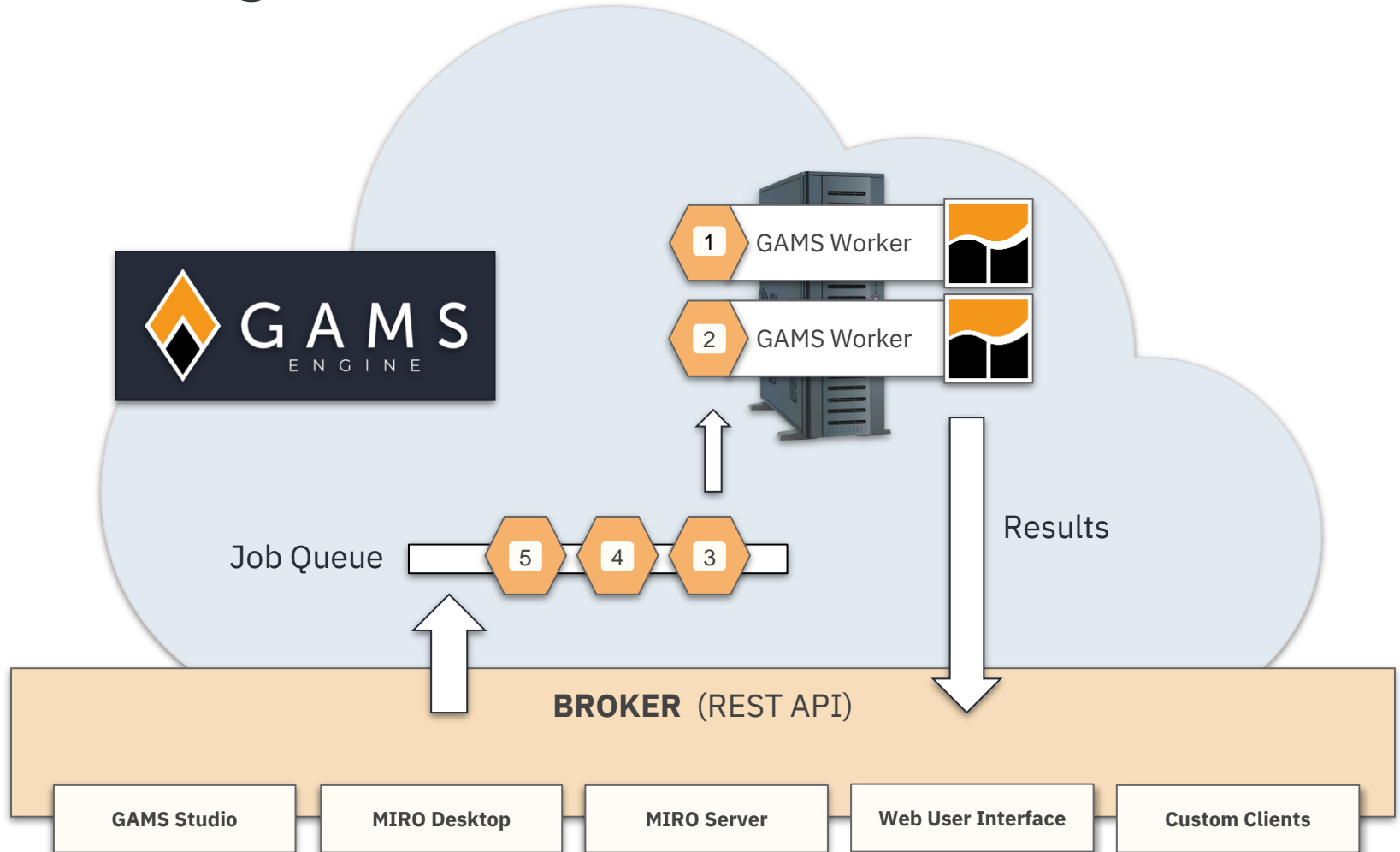
Veda

## Web User Interface



# GAMS Engine

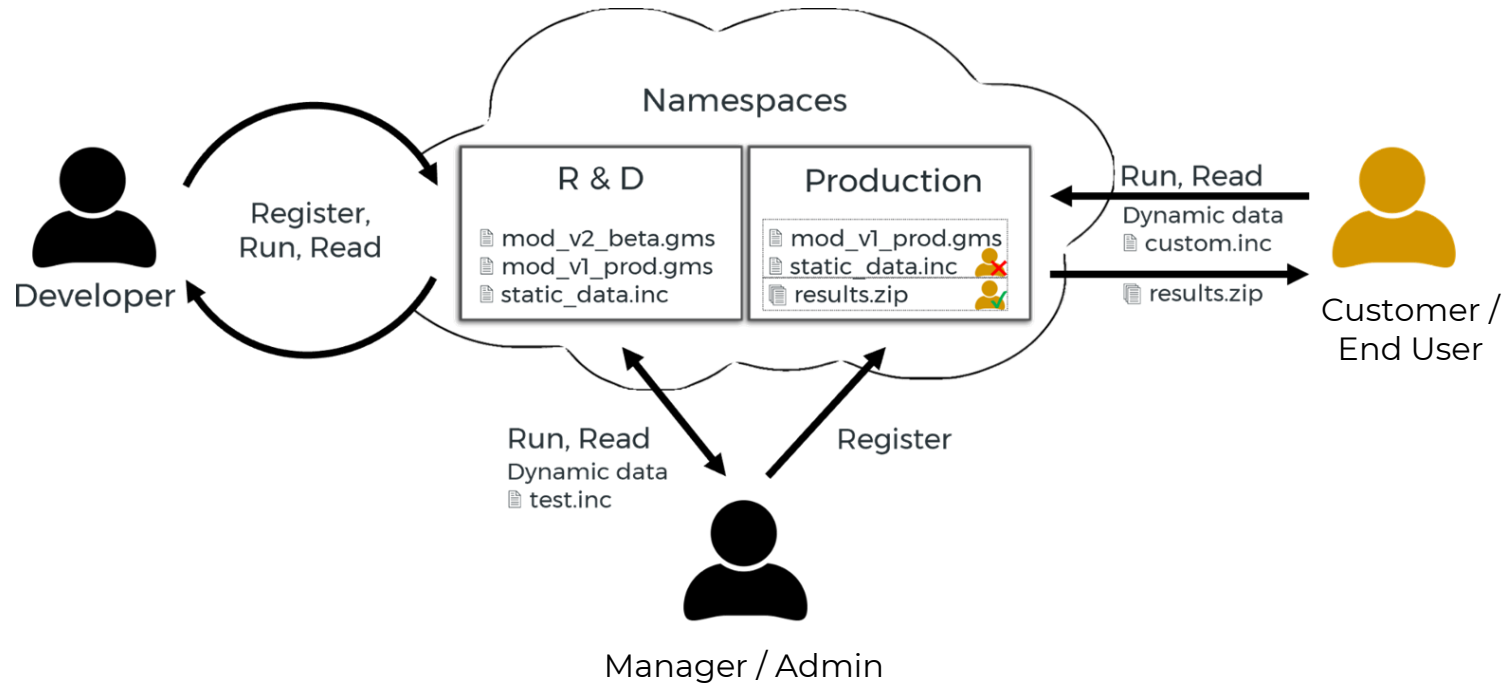
The Technology behind the TIMES Cloud Service



# GAMS Engine Summary of Features



## User Management



# GAMS Engine

## Summary of Features



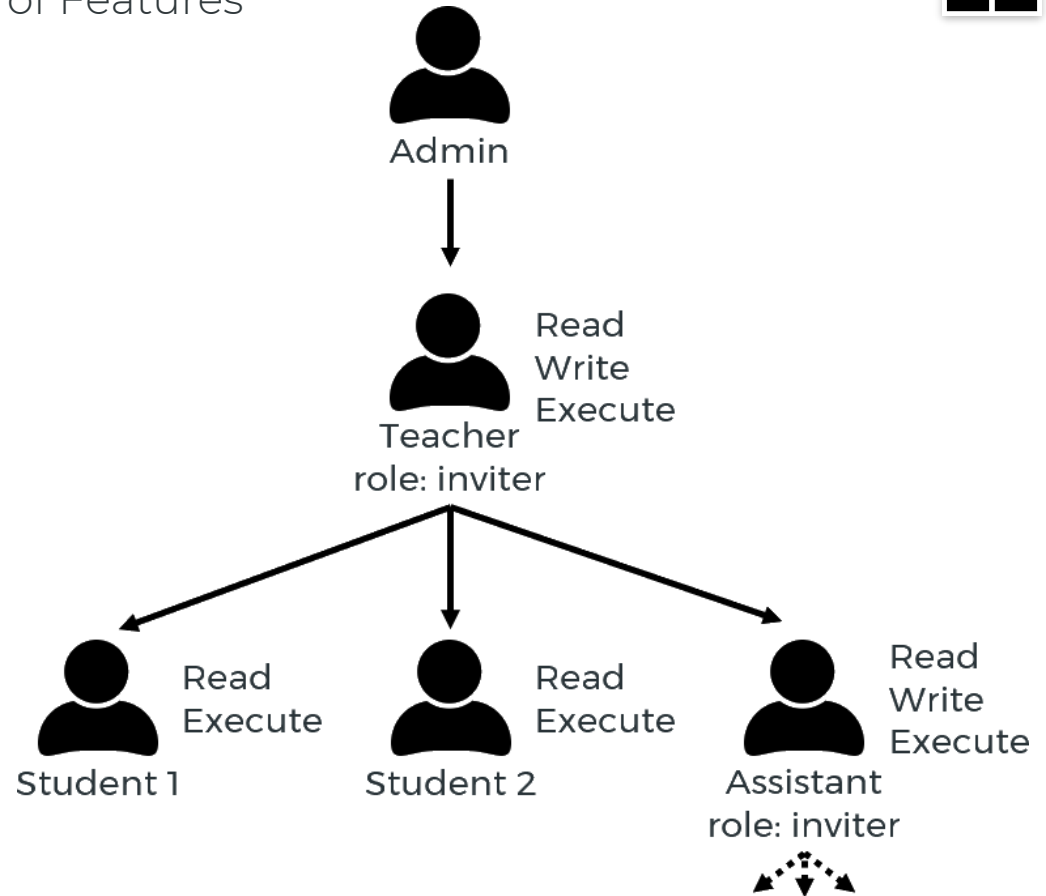
### User Management

Hierarchical user tree(s):

Root node are called “admins”

Leaf nodes are called “users”

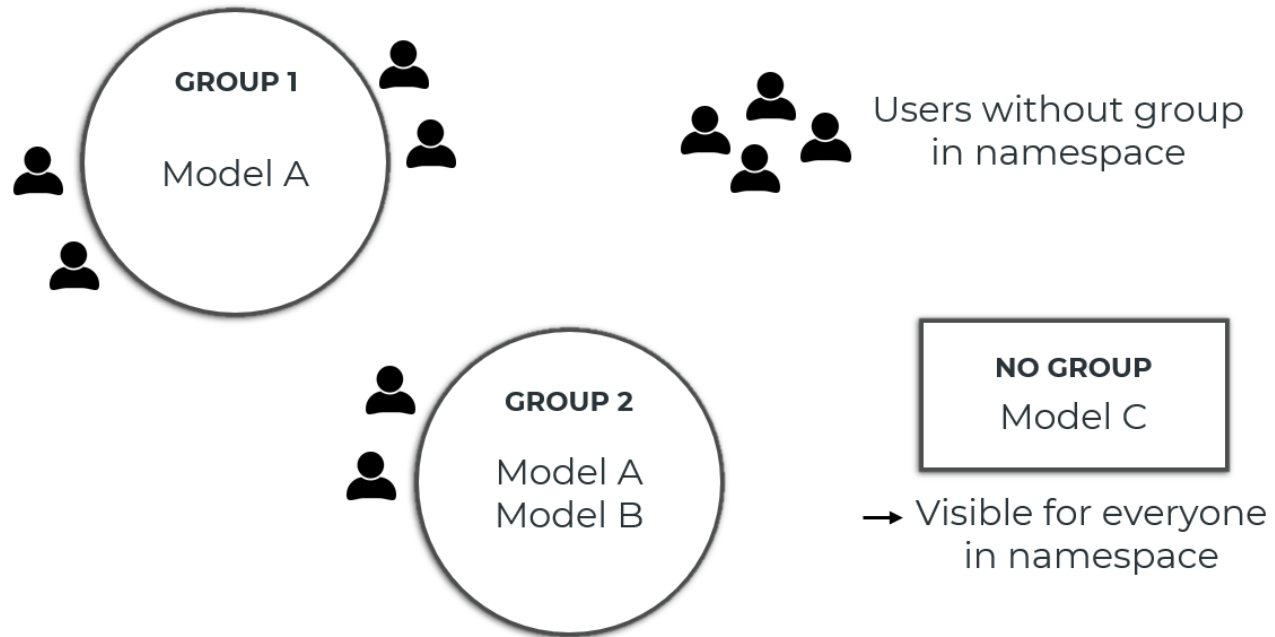
Other nodes are called “inviters”





## User groups

**Models** and jobs can be shared with groups



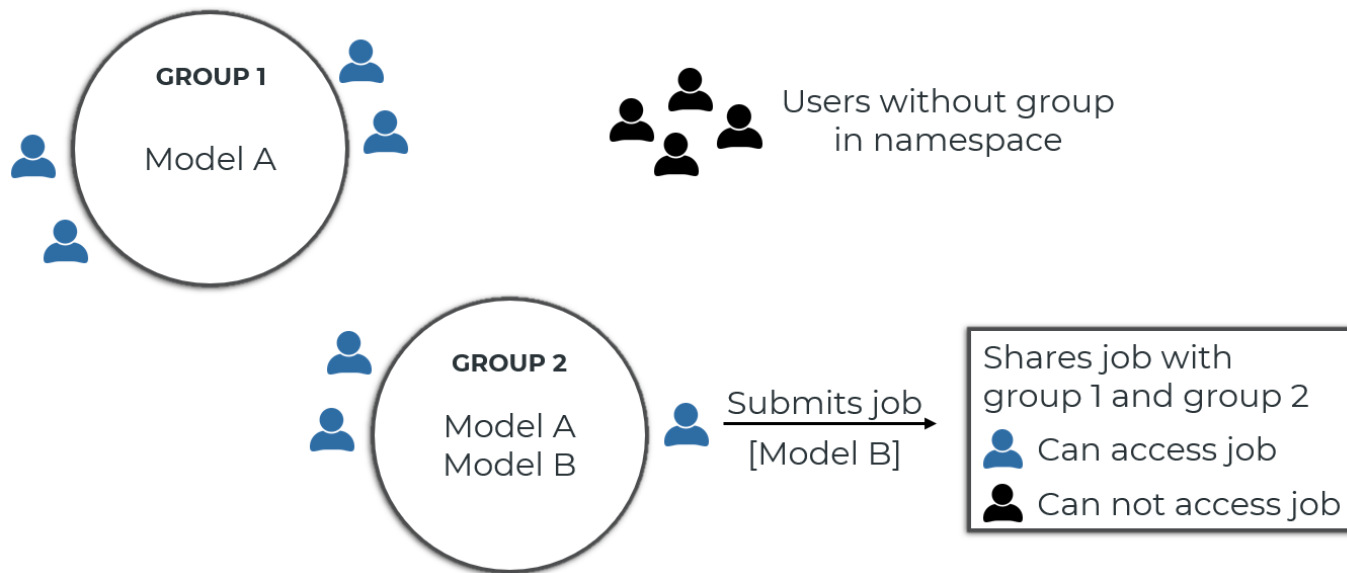


# GAMS Engine Summary of Features



## User groups

Models and **jobs** can be shared with groups





## User Management

Users can be assigned **quotas**:

- Volume quota to limit total solve time user is allowed to use
- Disk quota to limit how much disk space user is allowed to use
- Parallel quota to limit how many jobs user is allowed to use in parallel

Quotas are inherited, but can be further restricted



## Resource requests

- Resources (CPU/RAM/ephemeral disk) a job is allowed to use can be specified: Engine makes sure to schedule the job on a node with sufficient resources
- Resources can be bundled as so-called “instances”: a label is assigned to a set of resource requests (CPU/RAM/ephemeral disk)
- Instances that users are allowed to use can be restricted
- Allowed instances are inherited, but can be further restricted



# GAMS Engine Summary of Features

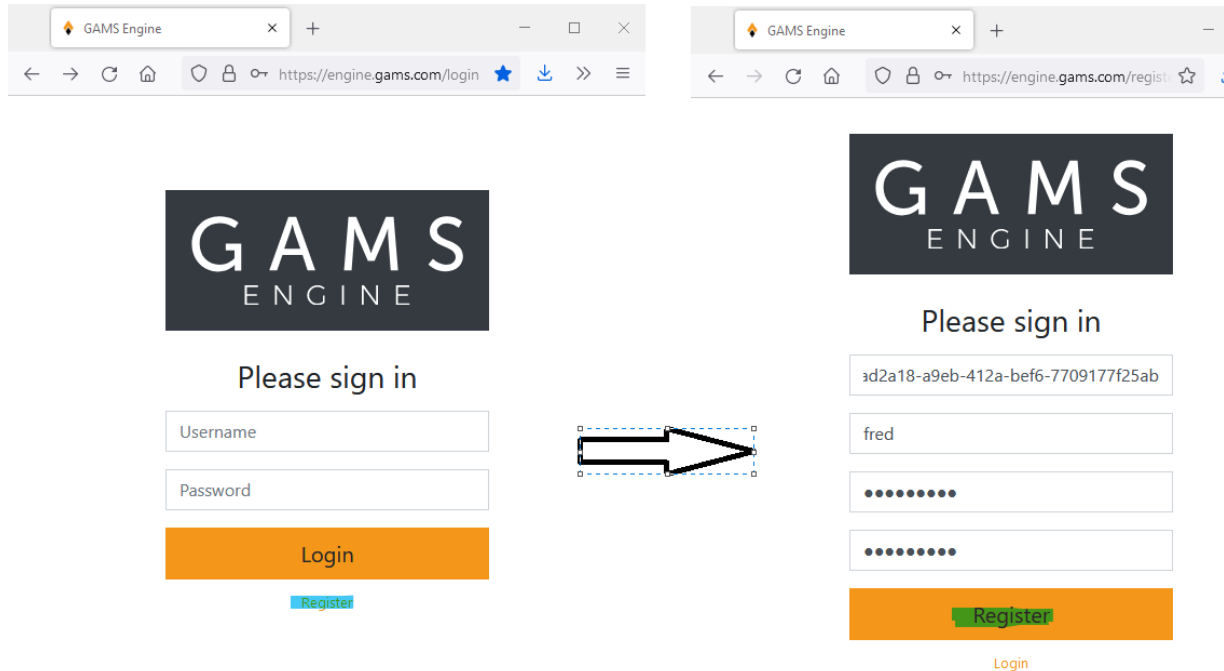
- System to run potentially long-running and computationally expensive tasks on centralized compute resources.
- The only interface to communicate with GAMS Engine is REST API
- Various clients
- User management system
- User quotas
- Resource requests
- User groups
- Hypercube Jobs
- Job dependencies
- Webhooks
- High Security standards
- ...

→ Read [more](#)

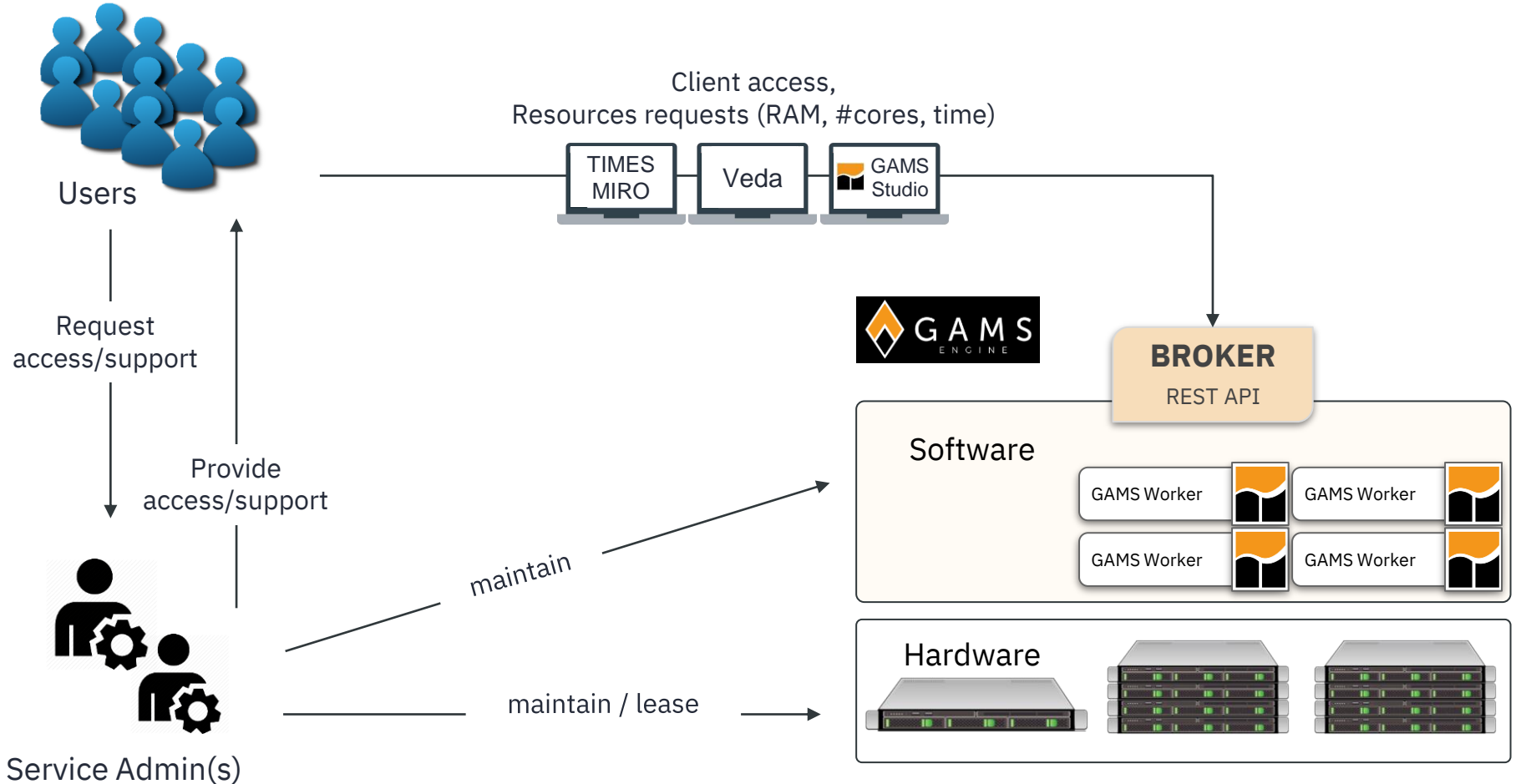


# How to get access?

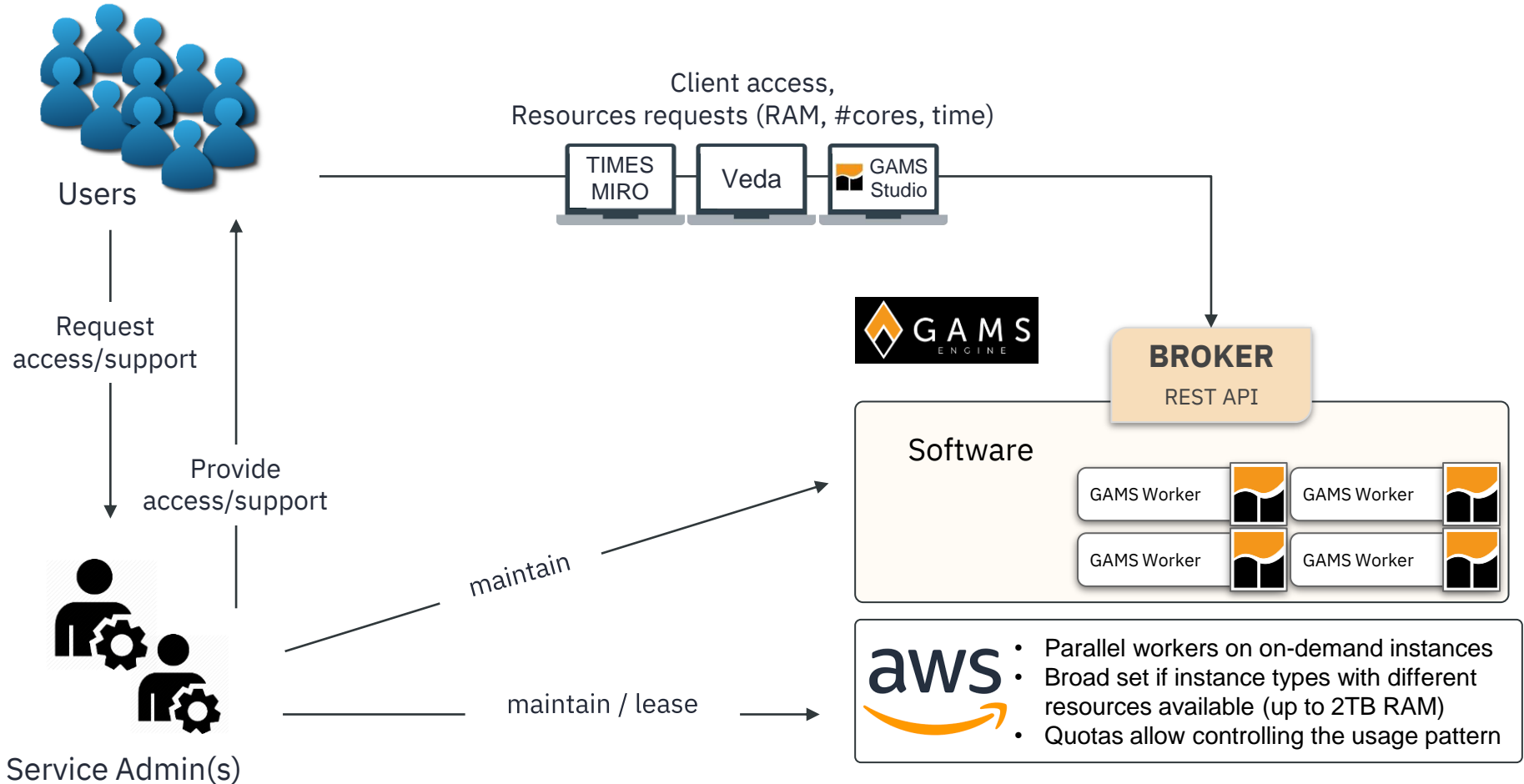
1. Request registration code by sending an email to [timescloud@etsap.org](mailto:timescloud@etsap.org) (currently restricted to ETSAP members)
2. Go to the TIMES cloud login page <https://engine.gams.com/login>



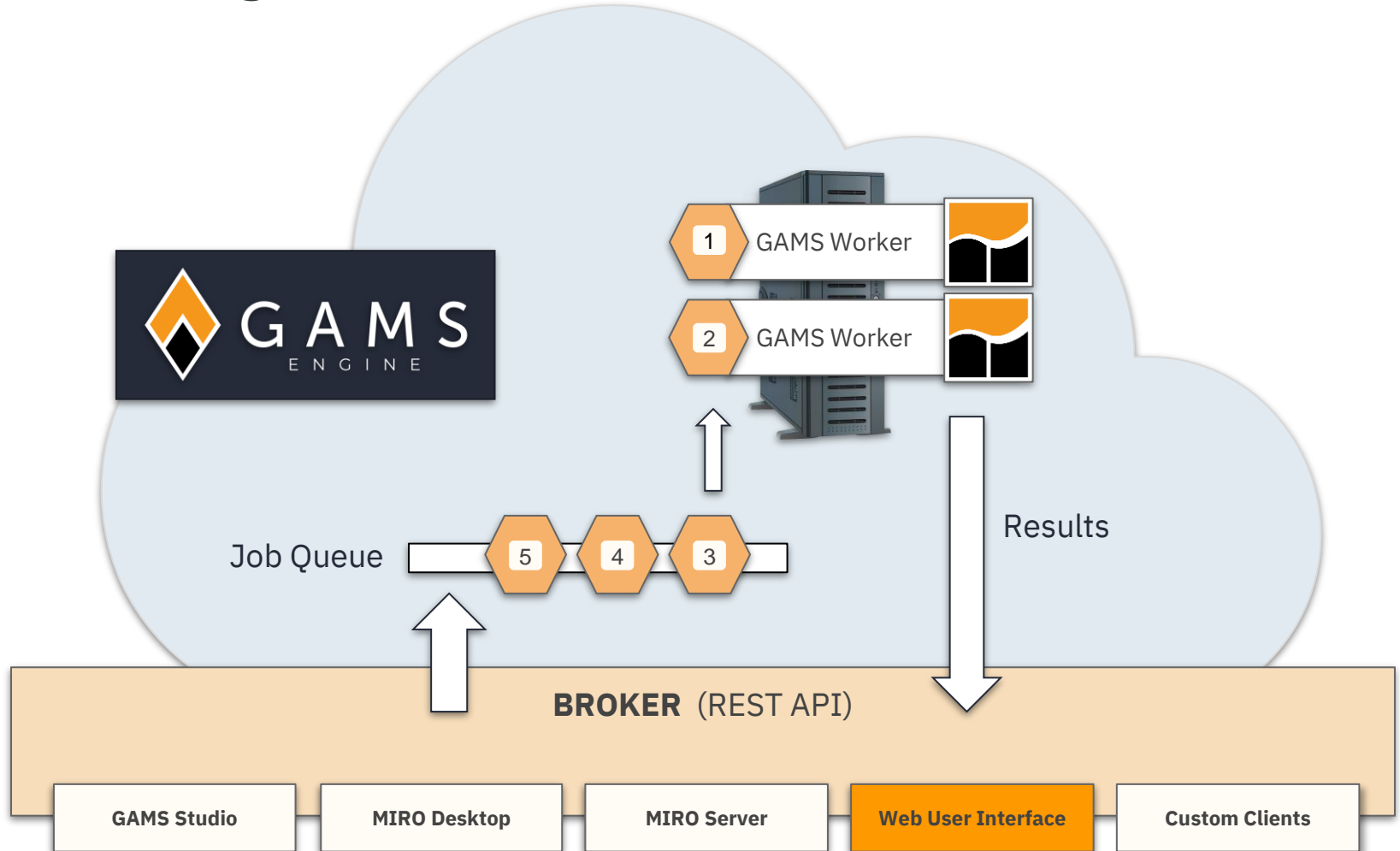
# TIMES Cloud Service Roles & Components



# TIMES Cloud Service Roles & Components



# GAMS Engine Clients





# GAMS Engine UI User Management



admin

→ Sign Out

Change password

Jobs

Models

Users

Cleanup

GAMS  
ENGINE

License expires in: 29 days

Users

Update Engine license

Update GAMS license

Invite User ↕

Refresh ↺

User	Role	Invited by	Created ↓	Actions
stefan		smann	<div>an hour ago</div>	<div>Update license</div> <div>Show usage</div> <div>Edit</div> <div>Delete</div>
smann	inviter	admin	<div>3 hours ago</div>	<div>Update license</div> <div>Show usage</div> <div>Edit</div> <div>Delete</div>
rschuchmann	inviter	admin	<div>a day ago</div>	<div>Update license</div> <div>Show usage</div> <div>Edit</div> <div>Delete</div>
admin <div>me</div>	admin		<div>Invalid date</div>	<div>Update license</div> <div>Show usage</div>

# GAMS Engine UI Registered Models



8

→

Sign Out

Change password

Preferences

▶

Jobs

📦

Models

👤

Users

🔗

Webhooks

GAMS

ENGINE

22.05.05 / GAMS 39.1.0

Models

Namespaces

TIMES

TIMES\_global

TIMES\_miro\_server

Models

Groups

Model ↑ ▾	Upload date	Arguments	Actions
latest	<div>🕒 2 months ago</div>	idir1=source,idir2=model,fileCase=2	<div>Download</div> <div>Update</div> <div>Delete</div>
times452	<div>🕒 4 months ago</div>	idir1=model,idir2=source,filecase=2	<div>Download</div> <div>Update</div> <div>Delete</div>
times453	<div>🕒 4 months ago</div>	idir1=model,idir2=source,filecase=2	<div>Download</div> <div>Update</div> <div>Delete</div>
times454	<div>🕒 4 months ago</div>	idir1=model,idir2=source,filecase=2	<div>Download</div> <div>Update</div> <div>Delete</div>
times458	<div>🕒 4 months ago</div>	idir1=model,idir2=source,filecase=2	<div>Download</div> <div>Update</div> <div>Delete</div>

Add Group

Add Model

Refresh

# GAMS Engine UI Jobs



8

[Sign Out](#)

[Change password](#)

[Preferences](#)

[Jobs](#)

[Models](#)

[Users](#)

[Webhooks](#)

## GAMS <sup>K</sup> ENGINE

22.05.05 / GAMS 39.1.0

### Jobs

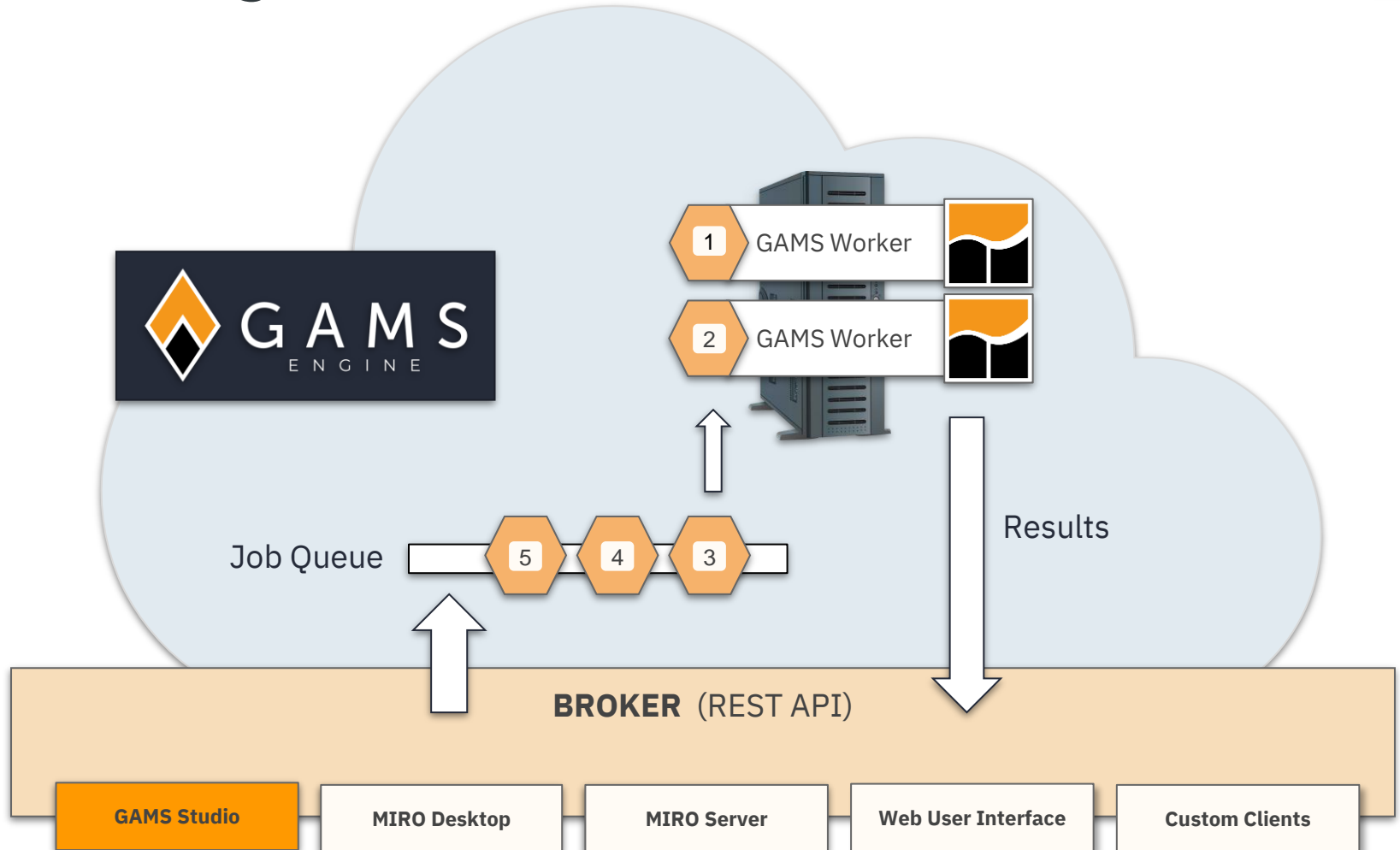
[New Job](#) [New Hypercube Job](#) [Show Active](#) [Refresh](#)

Jobs

Hypercube Jobs

Username	Model	Namespace	Tag	Submitted ↓	Status	Actions
	latest	TIMES		<a href="#">5 hours ago</a>	Finished	<a href="#">Show</a> <a href="#">Download</a>
	latest	TIMES		<a href="#">6 hours ago</a>	Finished	<a href="#">Show</a> <a href="#">Download</a>
	latest	TIMES		<a href="#">6 hours ago</a>	Finished	<a href="#">Show</a> <a href="#">Download</a>
	latest	TIMES		<a href="#">8 hours ago</a>	Finished	<a href="#">Show</a> <a href="#">Download</a>
	latest	TIMES		<a href="#">8 hours ago</a>	Finished	<a href="#">Show</a> <a href="#">Download</a>
	latest	TIMES		<a href="#">11 hours ago</a>	Finished	<a href="#">Show</a> <a href="#">Download</a>

# GAMS Engine Clients





# GAMS Engine Clients - GAMS Studio

tzig, G B, Chapter 3.3. In *Linear Programming and Extensions*.  
nceton University Press, Princeton, New Jersey, 1963.

s formulation is described in detail in:

enthal, R E, Chapter 2: A G  
Scientific Press, Redwood

Line numbers will not match  
ments.

words: Linear programming,  
fText

```
i 'canning plants' / seattle  
j 'markets' / new-york
```

ameter

```
a(i) 'capacity of plant i in cases'  
    / seattle 350  
    / san-diego 600 /
```

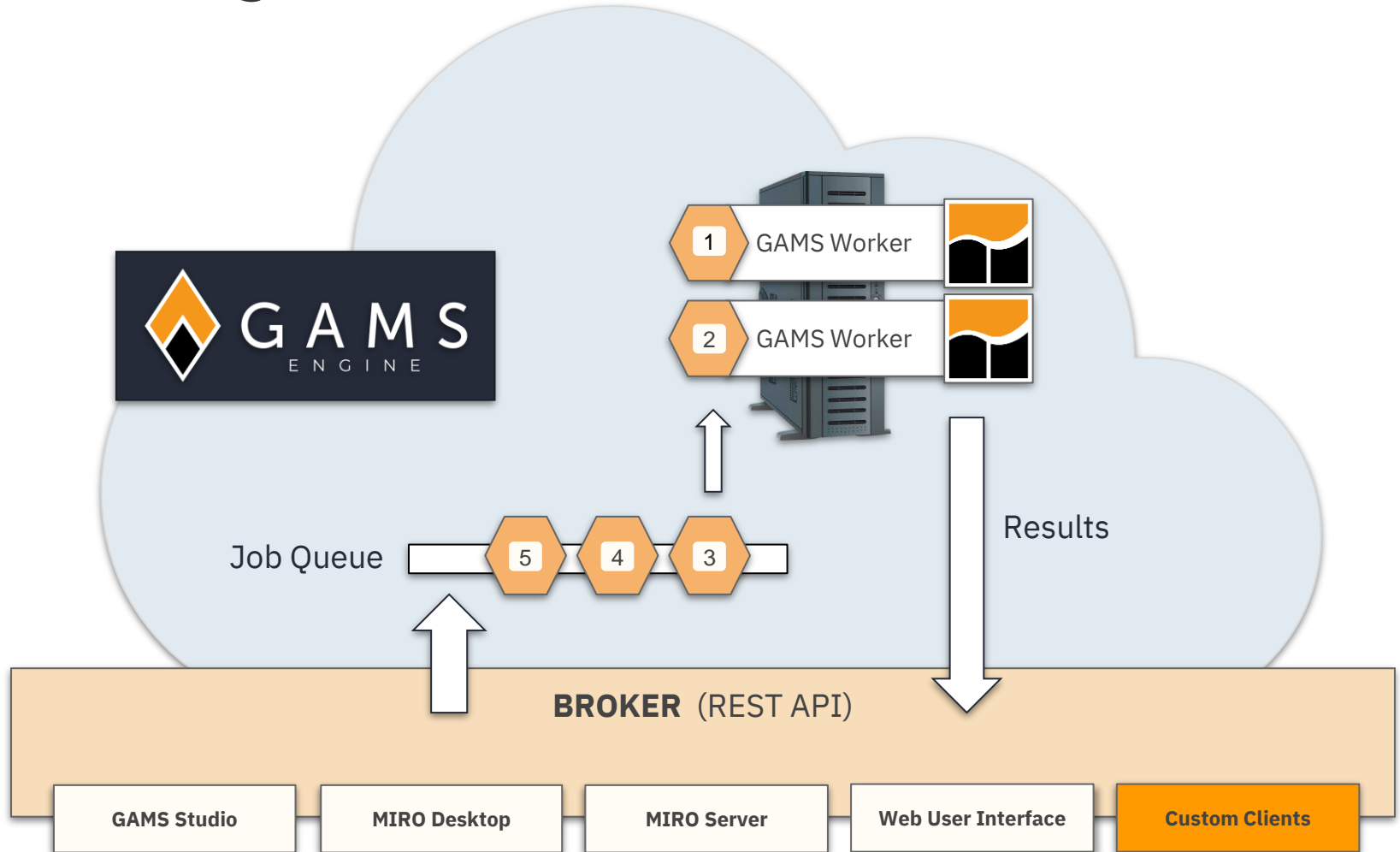
```
b(j) 'demand at market j in cases'  
    / new-york 325
```

The dialog box is titled "Submit Job" and features the GAMS logo. It contains the following fields and options:

- Engine URL:
- Namespace:
- Username:
- Password:
- ☒ Create GDXX file
- Buttons: "OK, don't ask again", "OK", and "Cancel"

Text at the top of the dialog: GAMS 35.1.0 Engine 21.05.04

# GAMS Engine Clients





## OpenAPI version 2.0

- language agnostic interface
- autogeneration for several languages (Python, Java, C, C#, C++, Node.js, Ruby...)

## REST API

- only point of contact for clients
- job scheduling, queuing, GAMS calls are all transparently handled by Engine

## Job submission

```
create_job_response = job_api_instance.create_job(model,
                                                  namespace,
                                                  model_data=model_data,
                                                  arguments=arguments)
```

## Downloading results

```
token = create_job_response.token
result_zip = job_api_instance.get_job_zip(token)
```

# GAMS Engine Custom Clients – VEDA



**GAMS Root**

Set GAMS Folders Path

Path: C:\VEDA\Veda

Source Times: GAMS\_SrcTIMES.v4.5.4

Work Times: GAMS\_WrkTIMES

Max Runs: 6

Study: pilot\_runs

Solver: CPLEX

Solver Option: CPLEX

☐ Restart Option ☐ DD Writing Only ☒ GAMS Engine ☐ VRQ

Save

**Runs Status**

Case Solver Status

Count: 1

**DD writing**

Creating zip file to submit to GamsEngine for case: DemoS\_012

Submitting job to GamsEngine for case: DemoS\_012

Waiting for job to complete for case: DemoS\_012

Downloading results for case: DemoS\_012

Importing files for case: DemoS\_012

Trying to establish connection with local PostgreSQL Server...

Database is accepting connections.

Trying to establish connection with local PostgreSQL Server...

Database is accepting connections.

Reading LST file @C:\VEDA\Veda\GAMS\_WrkTIMES\DemoS\_012\DemoS\_012.lst

Processing completed for file DemoS\_012\_1006.vds @C:\VEDA\Veda\GAMS\_WrkTIMES\DemoS\_012\DemoS\_012\_1006.vds

Processing completed for file DemoS\_012\_1006.vde @C:\VEDA\Veda\GAMS\_WrkTIMES\DemoS\_012\DemoS\_012\_1006.vde

Scenario Gr...	Region Gro...	Parametric...	Properties...	Periods Def...	Ending Year	GDX Refere...	Updat...
DemoS_012	AllRegion		Save sol infor...	pdef-11	2050	False	10-06-2...

**DD writing**

Creating zip file to submit to GamsEngine for case: DemoS\_012

Submitting job to GamsEngine for case: DemoS\_012

Waiting for job to complete for case: DemoS\_012

Downloading results for case: DemoS\_012

Importing files for case: DemoS\_012

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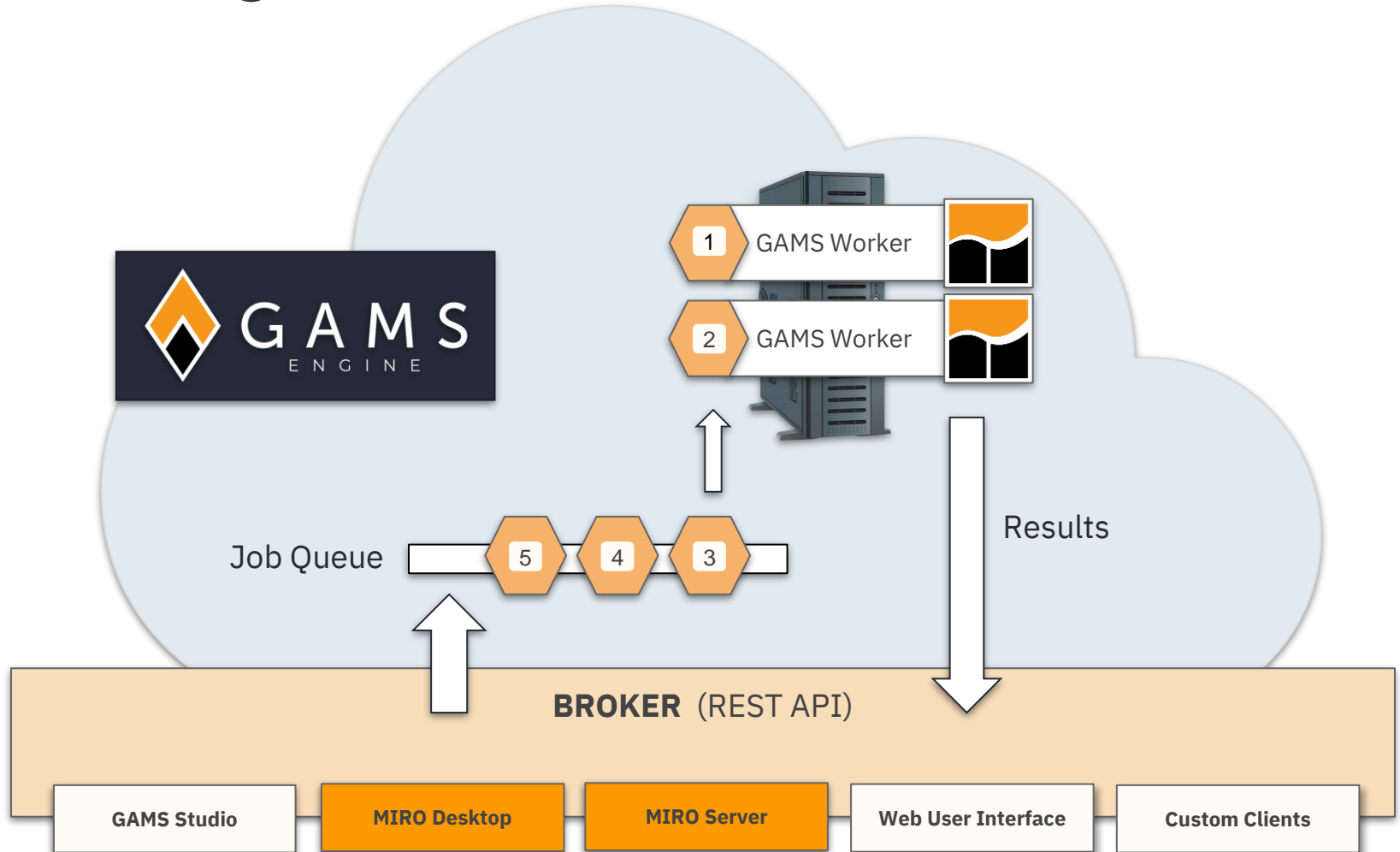
Processing completed for file DemoS\_012\_1006.vds @C:\VEDA\Veda\GAMS\_WrkTIMES\DemoS\_012\DemoS\_012\_1006.vds

Processing completed for file DemoS\_012\_1006.vde @C:\VEDA\Veda\GAMS\_WrkTIMES\DemoS\_012\DemoS\_012\_1006.vde

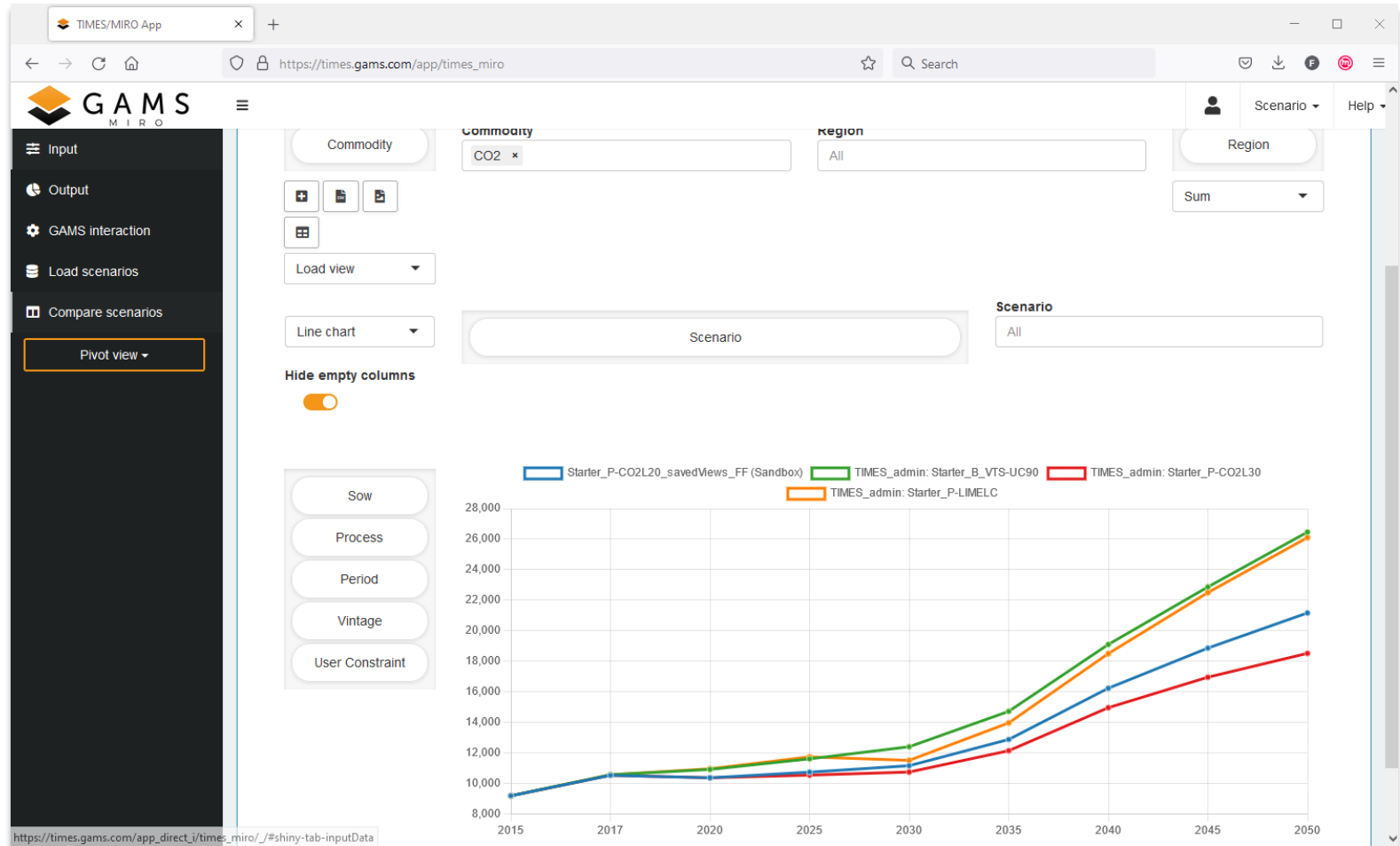
Solve



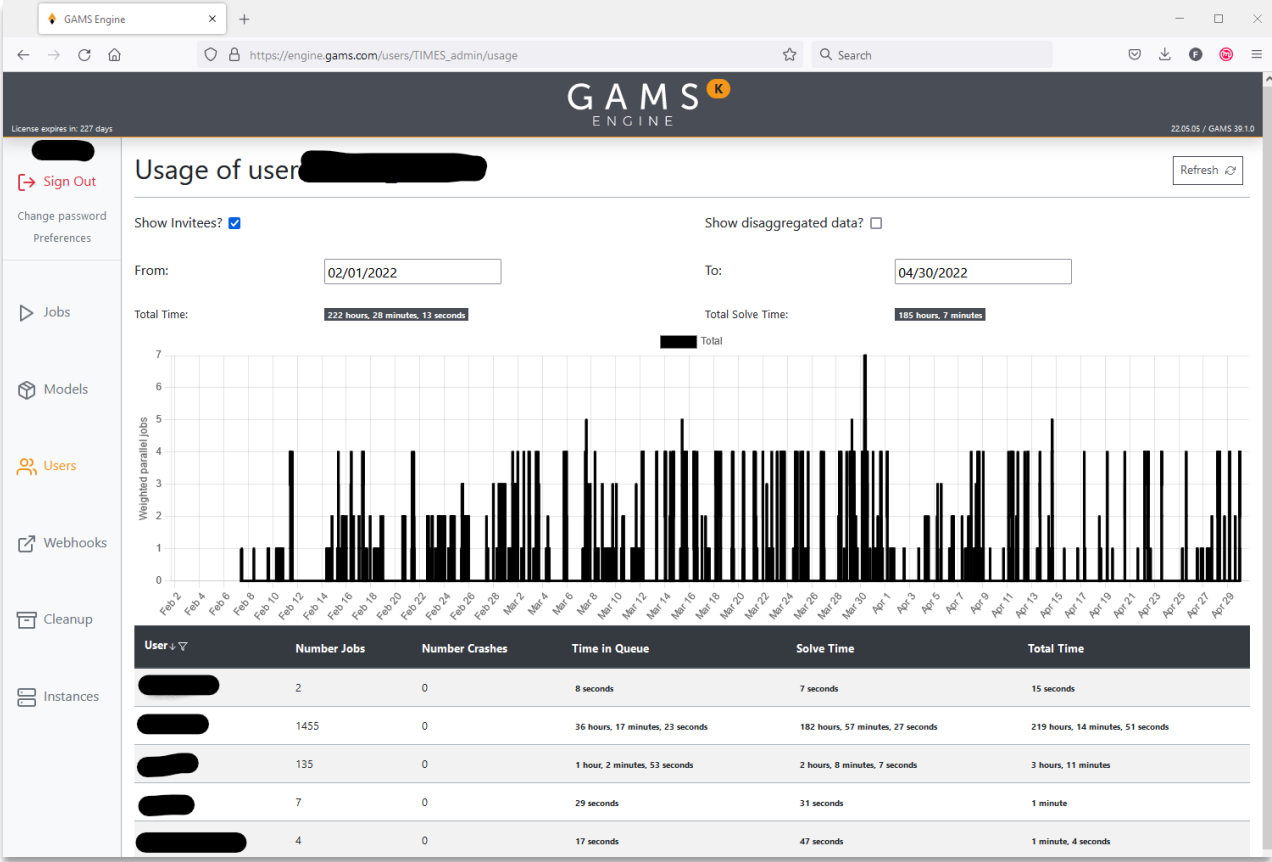
# GAMS Engine Clients



# GAMS Engine Clients - The TIMES MIRO App ([GitHub](#))



# TIMES Cloud Service Statistics



2022

- 14 users
- 1940 jobs
- 301+ hours of solve time
- 0 crashes



# Key Benefits

The TIMES Cloud Service (and the TIMES MIRO app) enhance...

- the **diversity**
- the **transparency**
- the **affordability**

... of the TIMES toolbox.

- Attract new user groups
- Facilitate new ways to disseminate TIMES models
- Increase the openness of the TIMES modelling framework



# Thank You!

[ffiand@gams.com](mailto:ffiand@gams.com)

[www.gams.com](http://www.gams.com)



[@GamsSoftware](https://twitter.com/GamsSoftware)



<https://www.linkedin.com/company/gams-development>