

# MATLAB EXPO

## Deploying Cloud-Native Algorithms in Kubernetes

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MATLAB  
EXPO

WELCOME



**MathWorks** 

@MathWorks

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**#MATLABEXPO**



# How do you deploy your MATLAB algorithms today?

- Standalone executables
- Compiled shareable library
- Web Service
- Embedded Code
- Other





# Optimizing cost with Simulation and Digital Twins

Carl Wouters

[Link to User Story](#)



# Frontier Advisors Develops Web-Based Platform for Portfolio Analytics

“MATLAB and MATLAB Compiler SDK enabled us to rapidly deliver a sophisticated portfolio analytics web application with confidence that it will return accurate results extremely quickly, ensuring a highly usable and stable platform for our clients.”

— Lee Eriera, Frontier Advisors



» [Learn about Frontier Advisors Technology](#)

## Challenge

Provide clients with an industry-first web platform for portfolio modelling and analytics

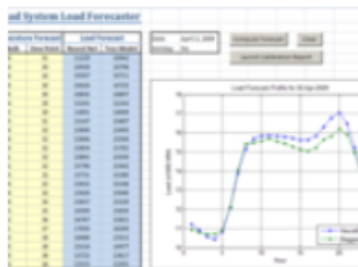
## Solution

Use MATLAB to develop and test analytics modules, and use MATLAB Compiler SDK to deploy them into a production .NET environment

## Results

- Quantitative development decoupled from interface development
- Stable, responsive system deployed
- Rapid delivery of new features enabled

[Link to User Story](#)



## Electricity Load and Price Forecasting Webinar Case Study

version 1.7.0.1 (12.3 MB) by [Ameya Deoras](#)

Slides and MATLAB® code for the day-ahead system load and price forecasting case study.

★★★★★ (25)

30.7K Downloads

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Overview

Functions

Examples

Reviews (25)

Discussions (79)

### Electricity Load & Price Forecasting/

[importData.m](#)

### Electricity Load & Price Forecasting/Load/

[fetchDBLoadData\(startDate, endDate\)](#)

[genPredictors\(data, term, holidays\)](#)

[loadForecast\(date, temperature, isH...](#)

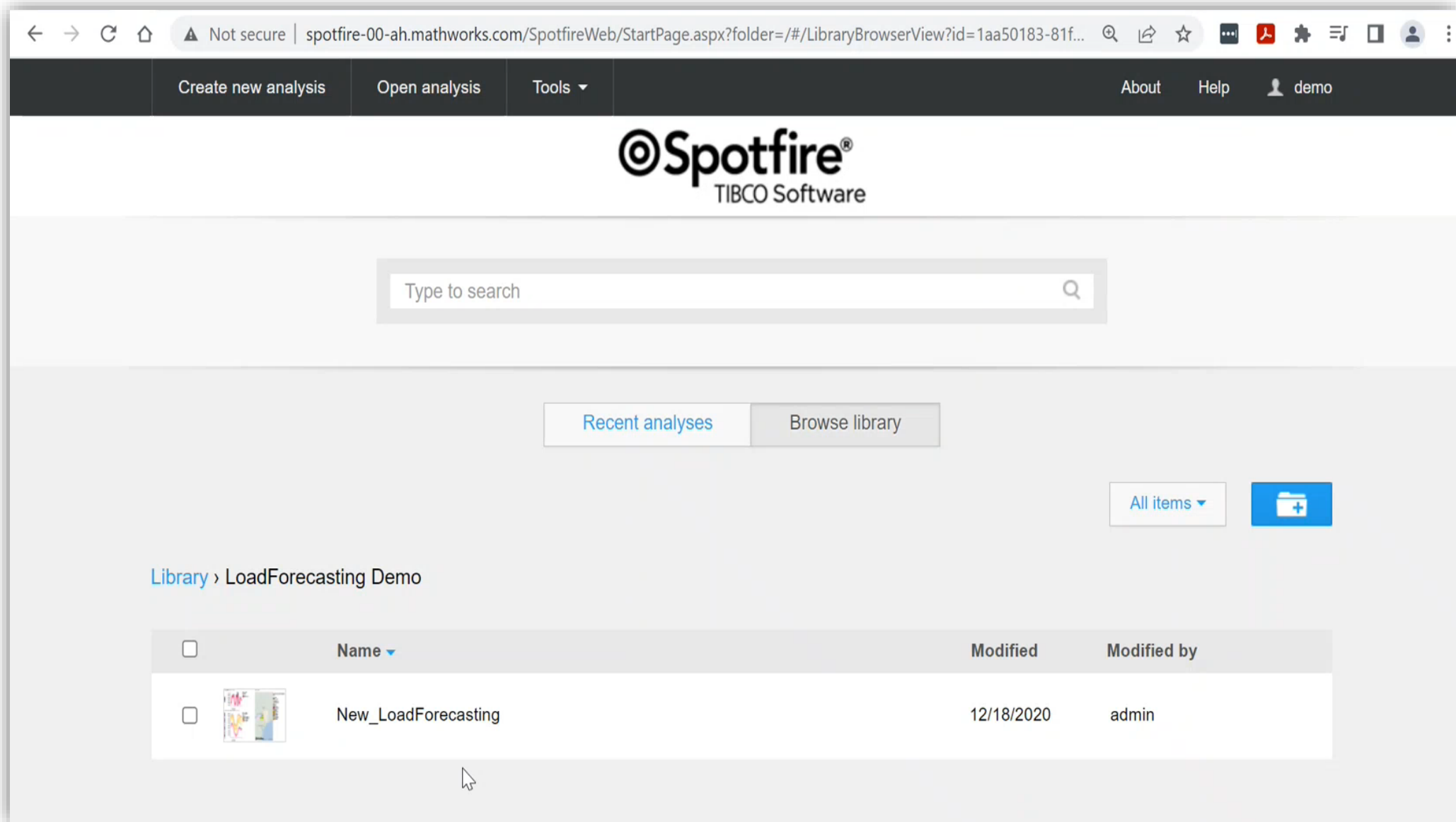
[TreesInDetail.m](#)

### Electricity Load & Price Forecasting/


```
function y = loadForecast(date, temperature, isHoliday)
% LOADFORECAST performs a day-ahead load forecast using a pre-trained
% Neural-Network or Bagged Regression Tree model
%
% USAGE:
% y = loadForecast(model, date, hour, temperature, isWorkingDay))

% Process inputs
date = datenum(date);
if date < 7e5 % Convert from Excel numeric date to MATLAB numeric date if necessary
    date = x2mdate(date);
end
```

# Load forecasting deployed on MATLAB Production Server

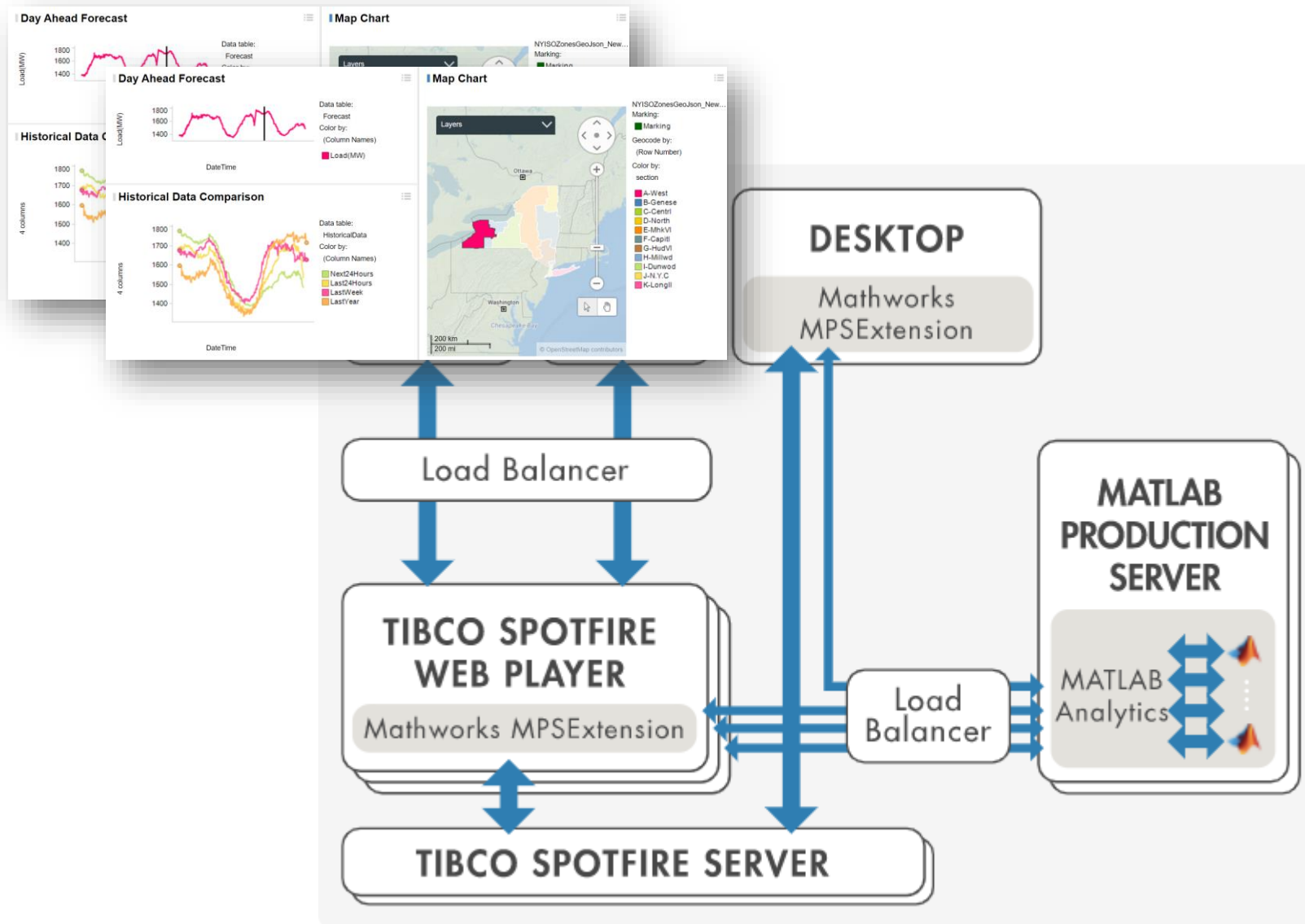


The screenshot displays the Spotfire web interface. At the top, there is a navigation bar with options: 'Create new analysis', 'Open analysis', 'Tools', 'About', 'Help', and a user profile 'demo'. The Spotfire logo and 'TIBCO Software' are centered below the navigation bar. A search bar with the placeholder 'Type to search' is positioned below the logo. Below the search bar are two buttons: 'Recent analyses' and 'Browse library'. To the right of these buttons are 'All items' and a blue button with a plus sign. The main content area shows the breadcrumb 'Library > LoadForecasting Demo'. Below this is a table listing items in the library.

<input type="checkbox"/>	Name ▾	Modified	Modified by
<input type="checkbox"/>	 New_LoadForecasting	12/18/2020	admin

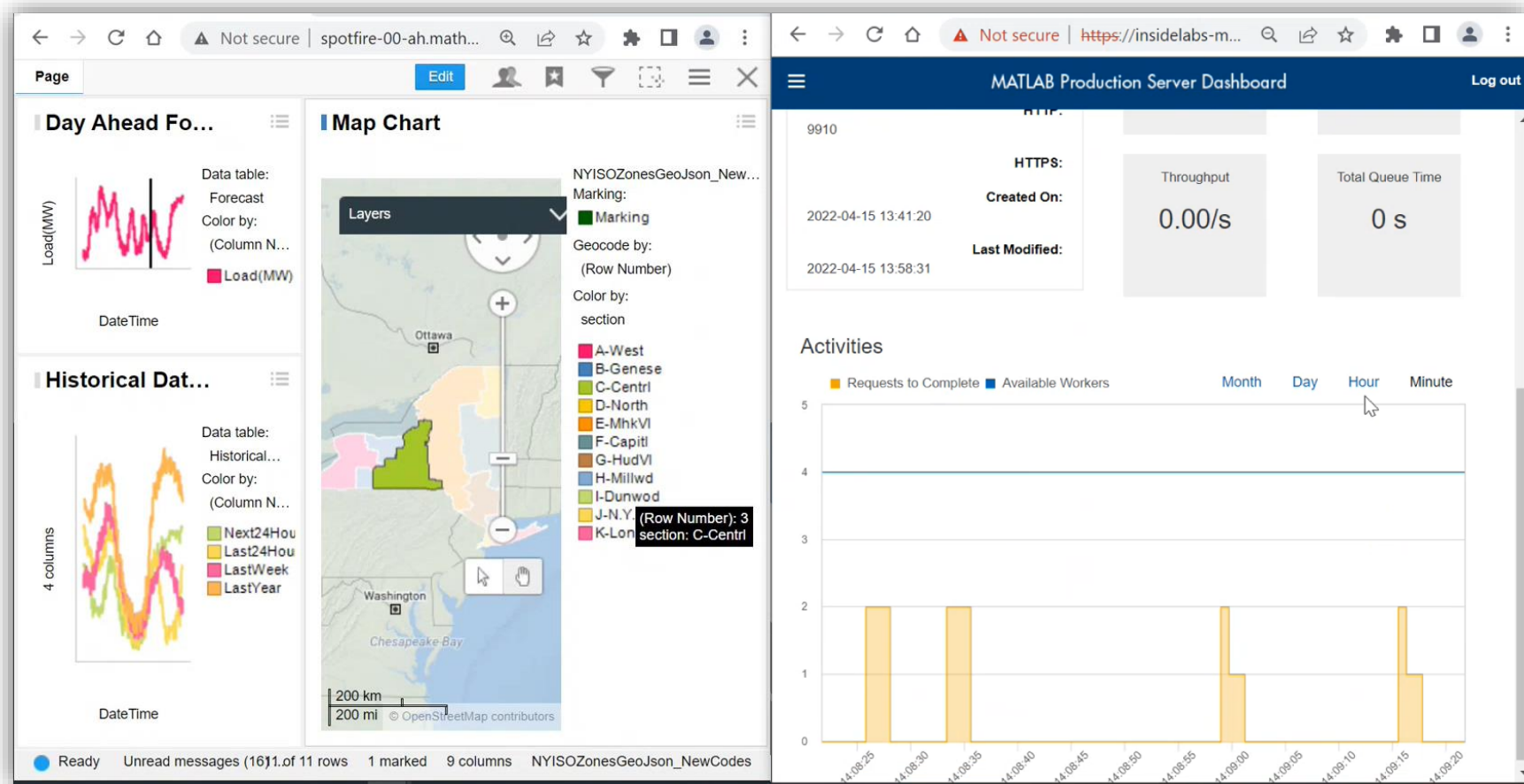
[Spotfire extension for MATLAB Production Server](#)

# Concurrent requests made to MATLAB Production Server





# Understanding resource utilization using production server dashboard



[Size your MATLAB Production Server](#)

# What to consider ?

## Accessibility

- Data
- Models
- APIs
- CI/CD

## Infrastructure

- Compute
- Memory
- Security
- Network Access

## Maintenance & Recovery

- Health Check
- Backup
- Server management

## Scalability

### Vertical

Bigger/Smaller server  
High up-front cost **vs** risk of running out of resources

### Horizontal

Number of nodes required concurrently  
Load balancing across nodes/VMs  
Regional and Global LBs

*Either way requires high maintenance if you keep on-premise !*

## Key Takeaways

- Deploying MATLAB algorithms into cloud-native webservices using MATLAB Production Server
- Comparing VM based and Container based provisioning of MATLAB Production Server
  - Selecting deployment strategy based on requirements
  - Available reference architectures
- New Kubernetes-hosted MATLAB Production Server is
  - Performant
  - Resilient
  - Provides on-demand scaling



## Which cloud platforms do you use?

- AWS
- Azure
- GCP
- Others



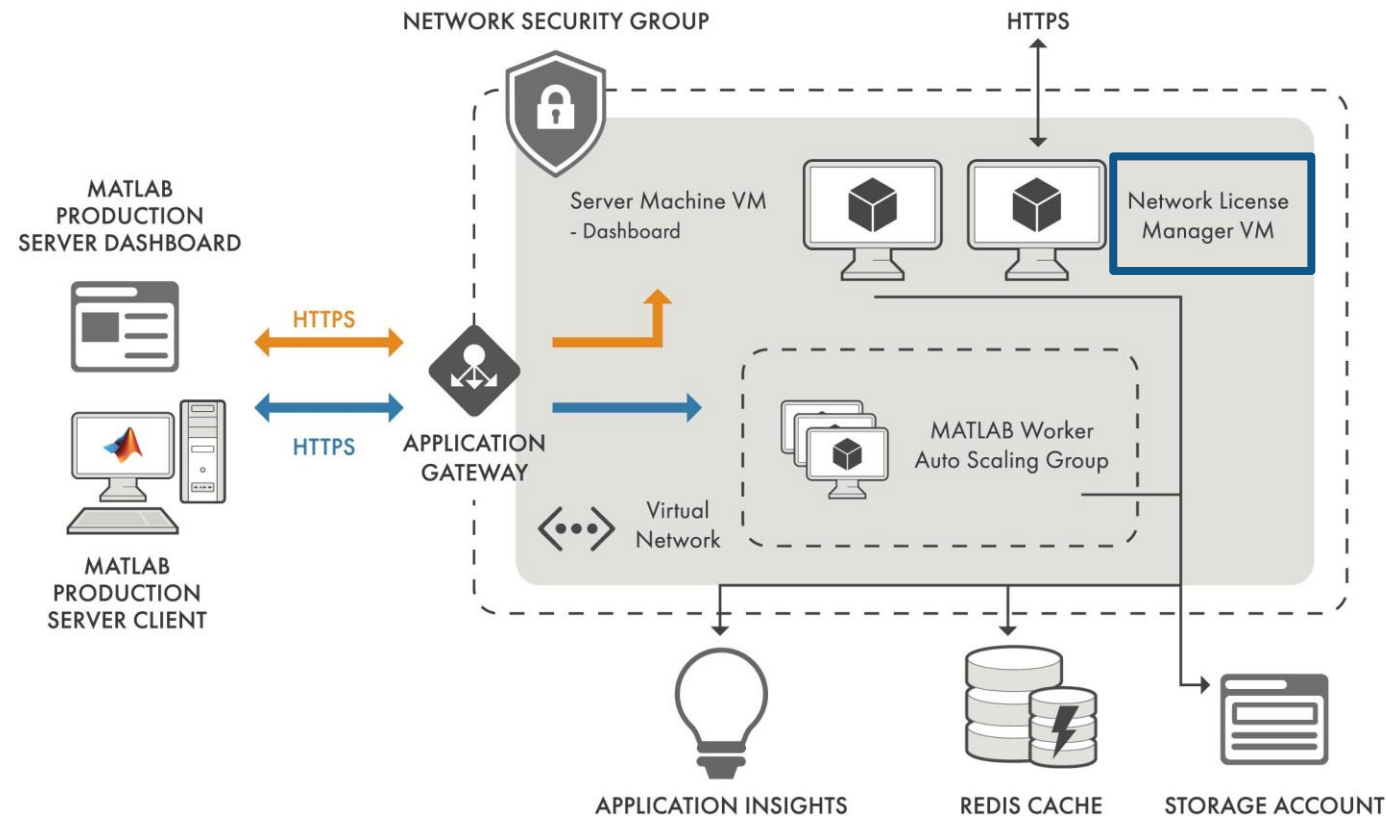
# Deploying to cloud using MATLAB Production Server

## VM based MATLAB Production Server:

- Every instance is a separate VM
- Windows or Linux OS
- Manual scaling capability
- Web dashboard configuration

## Reference Architectures available on GitHub:

- [AWS](#)
- [Azure](#)
- [GCP](#)





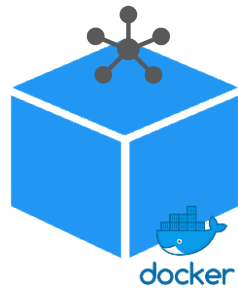
## Key Takeaways

- ✓ Deploying MATLAB algorithms using MATLAB Production Server
- ✓ VM based provisioning of MATLAB Production Server on cloud
- Container based provisioning of MATLAB and Simulink models on the cloud
- New Kubernetes-hosted MATLAB Production Server is
  - Performant
  - Resilient
  - Provides on-demand scaling

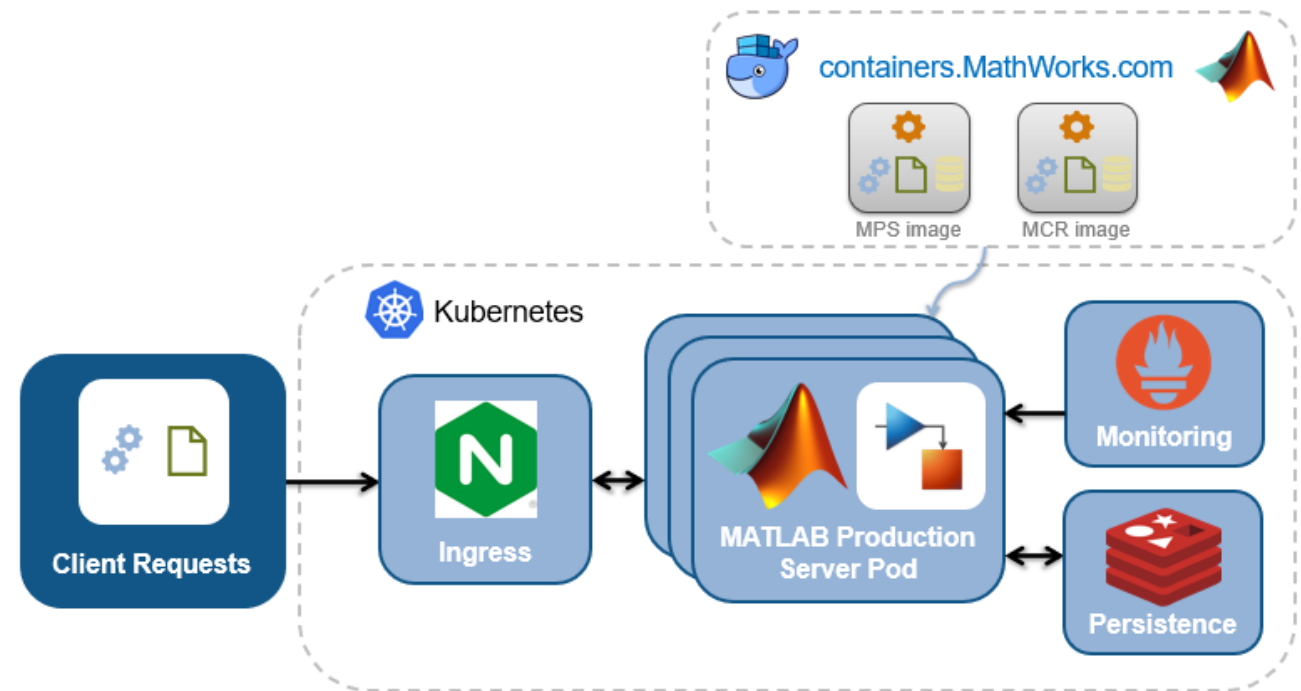
# Deploy MATLAB and Simulink algorithms in containers

Turn proof of concepts...

Into production web services deployed with DevOps principles



Package MATLAB models and Simulink simulations into a Docker container with RESTful HTTP endpoint(s) using the new microservice feature in MATLAB Compiler SDK R2022a



Turn those same MATLAB models and Simulink simulations into production-ready RESTful HTTP endpoint(s) with access control, autoscaling, and more

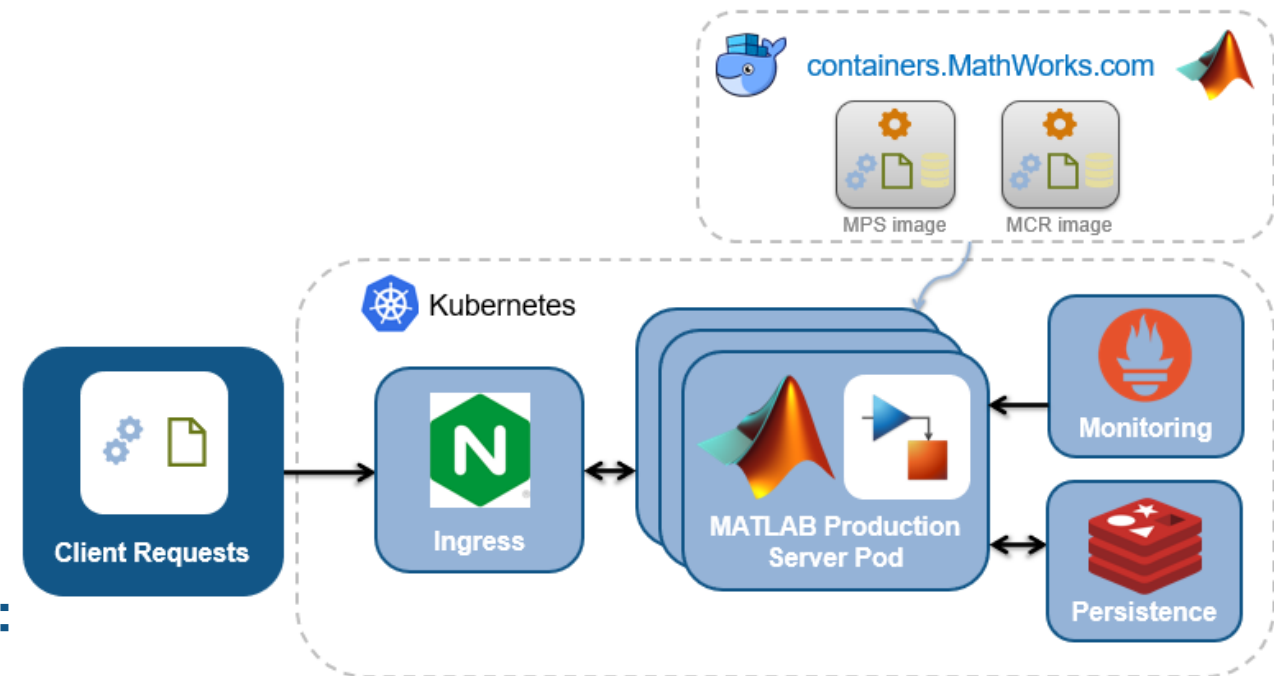
# Deploying to cloud using MATLAB Production Server

## Container-based MATLAB Production Server

- Any Kubernetes cluster (Vendor independent)
- Lightweight, lower upfront infrastructure cost (New pods can be started quickly)
- Linux only
- Autoscaling
- CLI configuration

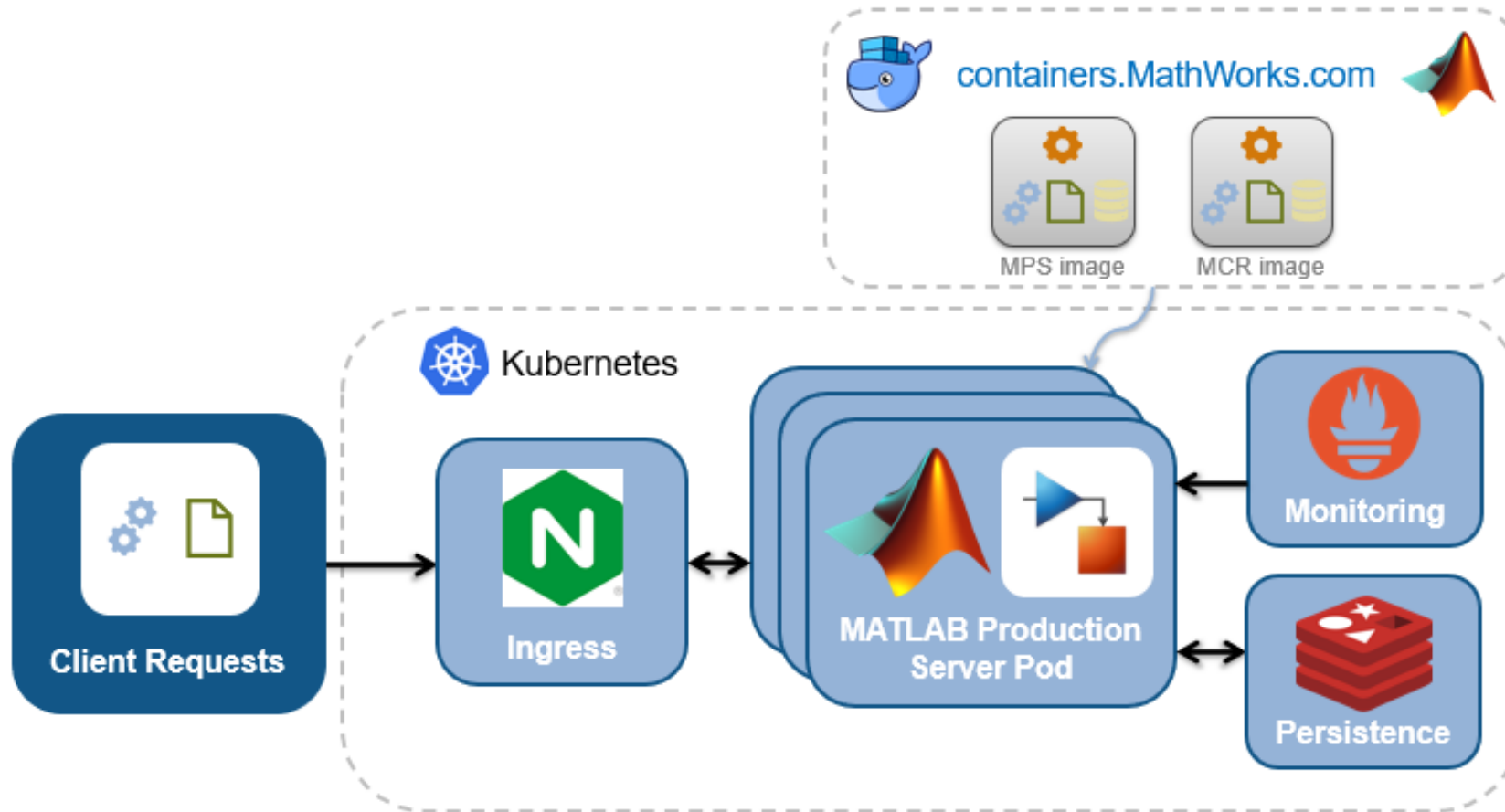
## Reference Architectures available on GitHub:

- [Any Kubernetes cluster, including AWS, Azure, and GCP](#)





# How can we manage containers?



# How can we manage containers? Enter: Kubernetes



Image source: <https://spot.io/blog/above-all-clouds-orchestrating-and-managing-kubernetes-across-cloud-and-on-premises>

# Kubernetes autoscaling based on requests

This makes it easy on solutions architect to design, plan and scale with a lot of flexibility

The screenshot shows the Kubernetes Dashboard for namespace 'mab'. The 'Deployments' section shows a table with one entry:

Name	Labels	Pods	Created	Images
mps-deployment	app: mps app.kubernetes.io/managed-by: Helm release: mps-ref-arch-1622931317	1 / 1	2.days.ago	localhost:5000/faas/bps-pcimj1682829-mps-Bps-1682829-r000

The 'Pods' section shows a table with one entry:

Name	Labels	Node	Status	Restarts	CPU Usage (cores)	Memory Usage (bytes)	Created
mps-deployment-7694d46f4-28c8l	app: mps pod-template-hash: 7694d46f4	mount-and-registry-worker	Running	0	~3.00m	954.82Mi	2.days.ago

**Adding resources**

The screenshot shows the Kubernetes Dashboard for namespace 'mab'. The 'Deployments' section shows a table with one entry:

Name	Labels	Pods	Created	Images
mps-deployment	app: mps app.kubernetes.io/managed-by: Helm release: mps-ref-arch-1622931317	2 / 2	2.days.ago	localhost:5000/faas/bps-pcimj1682829-mps-Bps-1682829-r000


The 'Pods' section shows a table with two entries:

Name	Labels	Node	Status	Restarts	CPU Usage (cores)	Memory Usage (bytes)	Created
mps-deployment-7694d46f4-x6x2v	app: mps pod-template-hash: 7694d46f4	mount-and-registry-worker	Running	0	~1.00m	317.95Mi	19.minutes.ago
mps-deployment-7694d46f4-28c8l	app: mps pod-template-hash: 7694d46f4	mount-and-registry-worker	Running	0	~2.00m	648.97Mi	2.days.ago

**Removing resources**

# Deploying K8s hosted MATLAB Production Server

```
nbonfatt@appdemos-ah:~/prodserverk8s$
```

A dark-themed terminal window with a light gray border. The prompt 'nbonfatt@appdemos-ah:~/prodserverk8s\$' is visible at the top left. A small cursor icon is visible on the right side of the terminal area.

# Which cloud architecture should we use?



**CTO**

Drives operational strategy

We would like to standardize on containers where possible to avoid cloud vendor lock-in and have repeatable, automated deployments

**MATLAB Production Server has a Kubernetes-based deployment Reference Architecture to make that easy.**



**System Architect**

Deploys and operationalizes models on Azure cloud





# Which cloud architecture should we use?



## Process Engineer

Develops models in  
MATLAB and Simulink



We have integrations that require  
Windows-based software

In that case, we should use a VM-based  
MATLAB Production Server deployment



## System Architect

Deploys and operationalizes  
models on Azure cloud

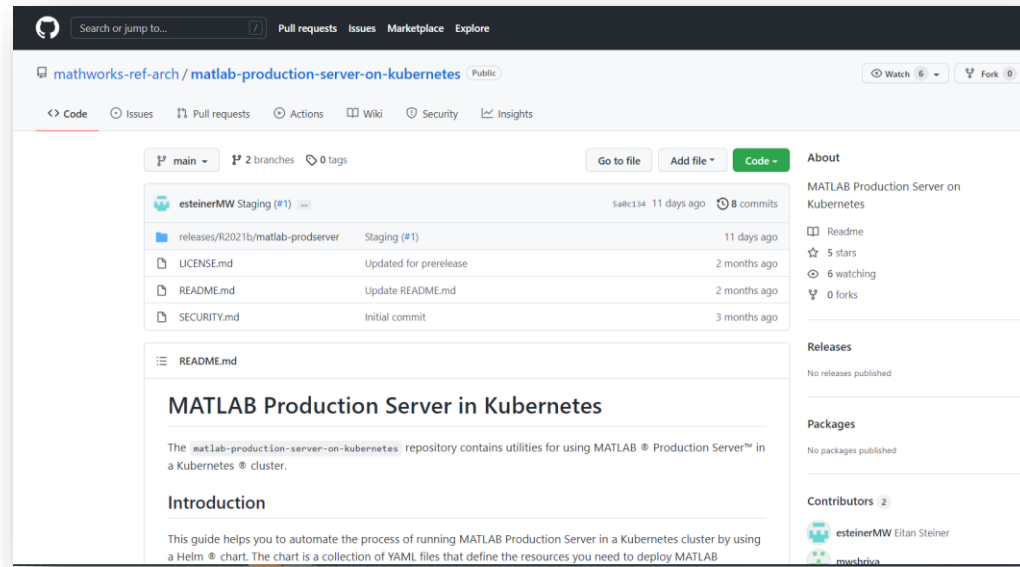


## Key Takeaways

- ✓ Deploying MATLAB algorithms into cloud-native webservices using MATLAB Production Server
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# Call to Action

*Explore the MATLAB Production Server Reference Architecture for Kubernetes*



<https://github.com/mathworks-ref-arch/matlab-production-server-on-kubernetes>

- Uses existing MATLAB license server
- Works with cloud-managed or on-premise Kubernetes clusters

```
nbonfatt@appdemos-ah:~/prodserverk8s$
```

I

# MATLAB EXPO

Thank you



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