MATLAB EXPO

Deploying Cloud-Native Algorithms in Kubernetes

Nick Bonfatti, MathWorks

Pallavi Kar, MathWorks

MathWorks


MATLAB
EXPO
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Share the EXPO experience
#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

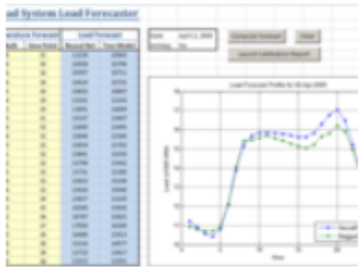
Solution

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.

Link

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)

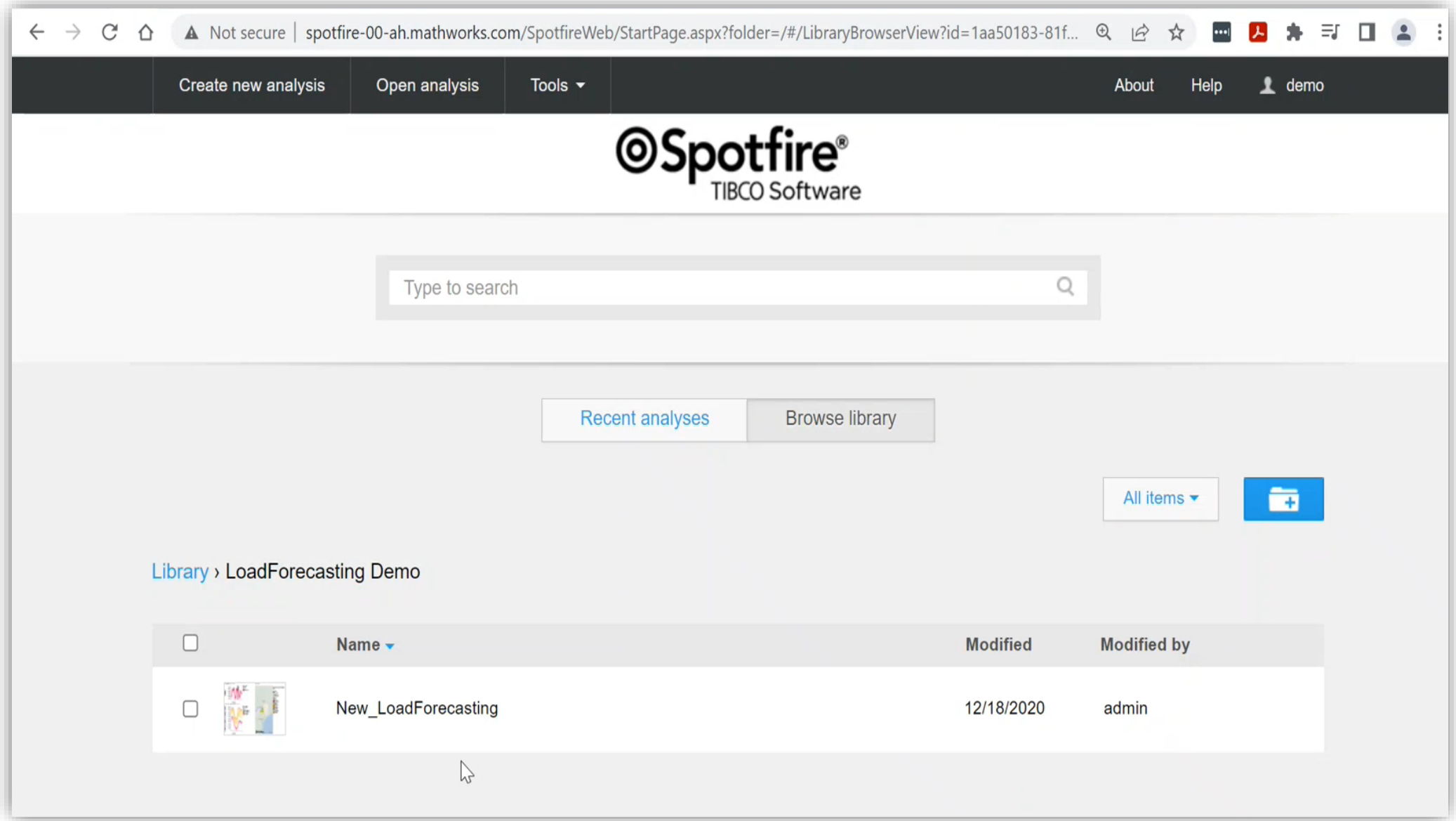
loadForecast(date, temperature, isH...

TreesInDetail.m

Electricity Load & Price Forecas

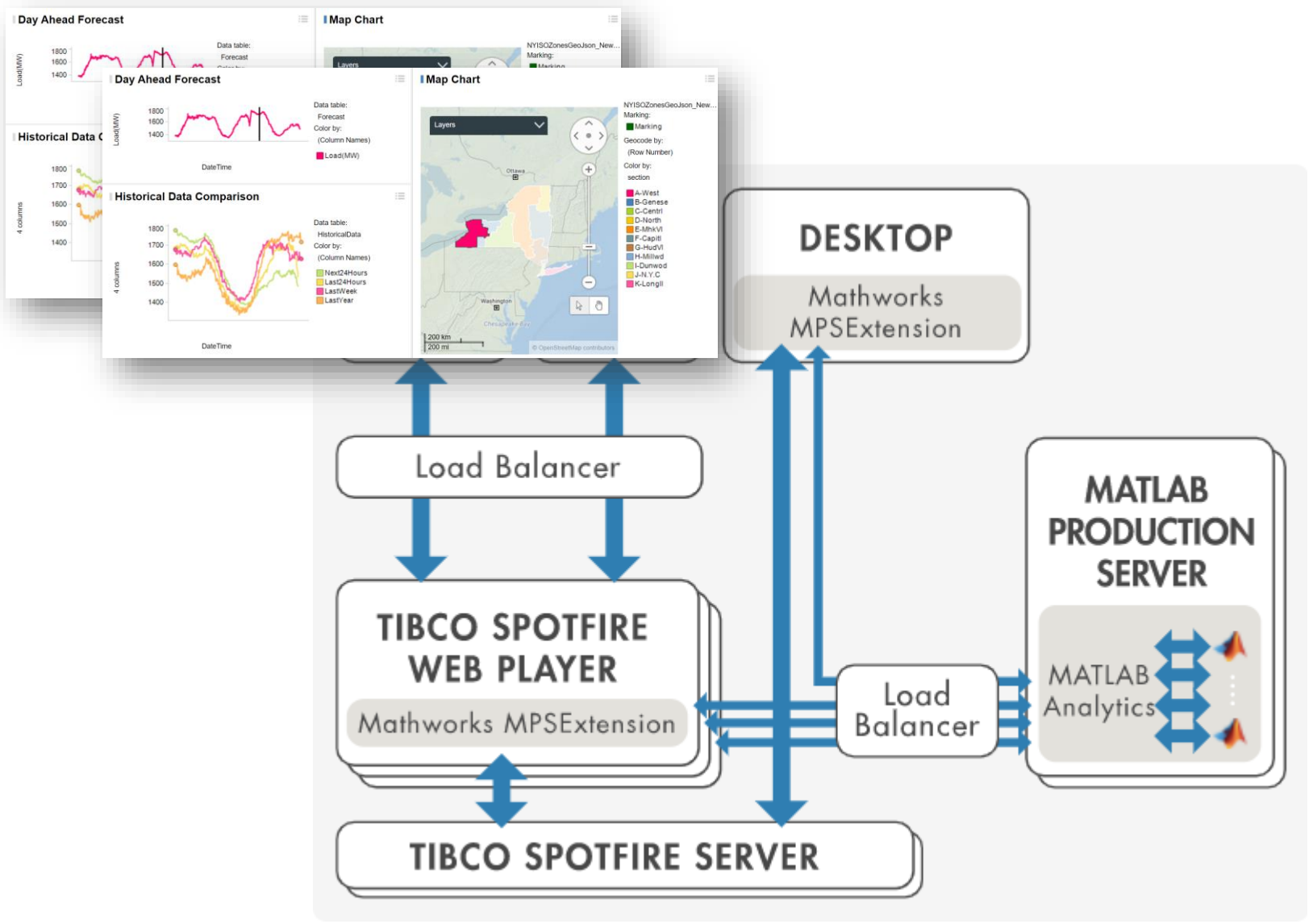
```
function y = loadForecast(date, temperature, isHoliday)
% LOADFORECAST performs a day-ahead load forecast using a pre-trained
% Neural-Network or Bagged Regression Tree model
%
% USAGE:
% y = loadForecast(model, date, hour, temperature, isWorkingDay))

% 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

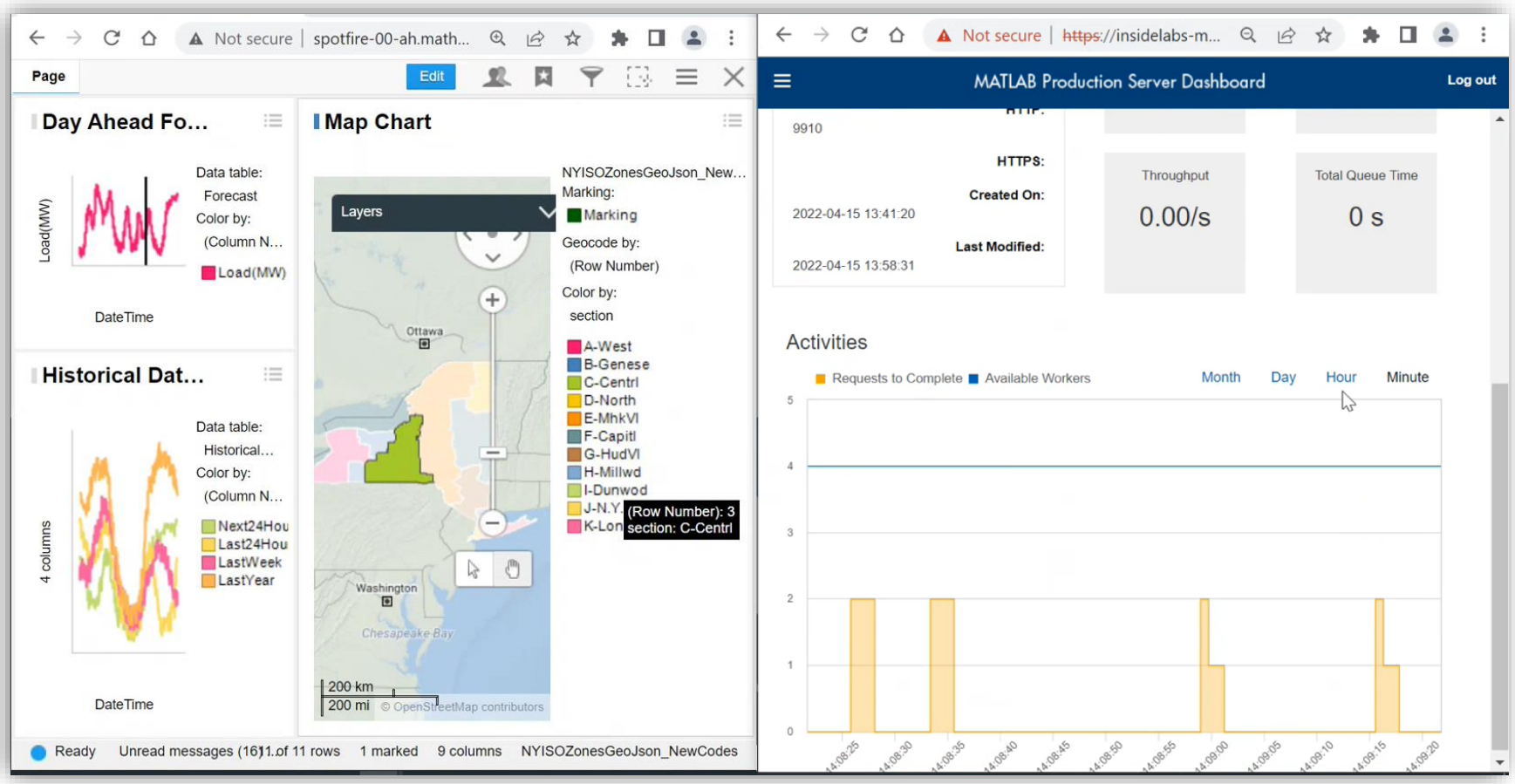


Spotfire extension for MATLAB Production Server

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 !

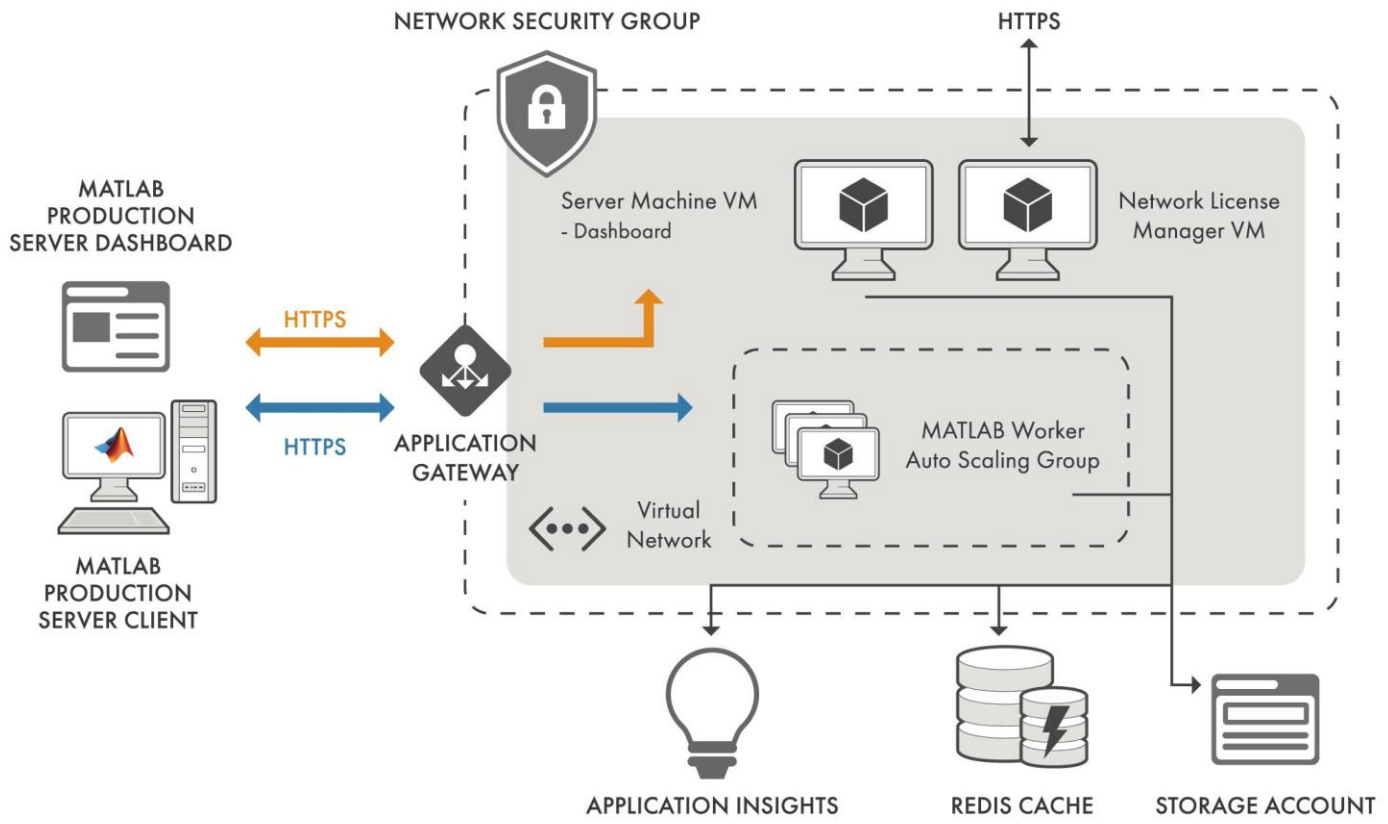
Key Takeaways

- 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

VM based reference architecture for MATLAB Production Server



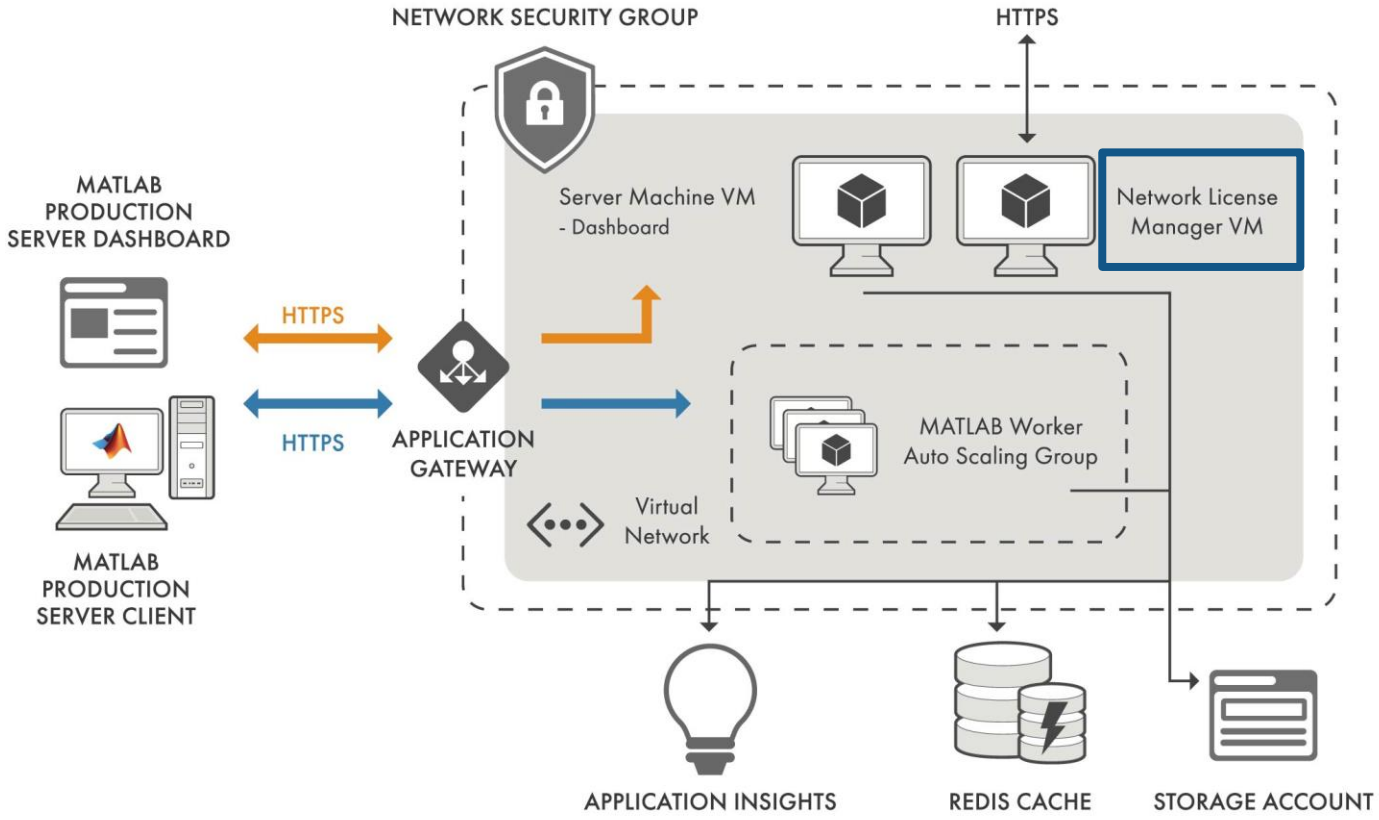
Deploying to cloud using MATLAB Production Server

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
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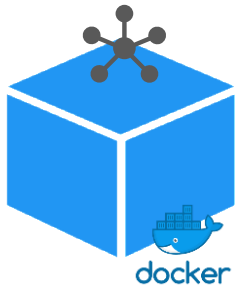
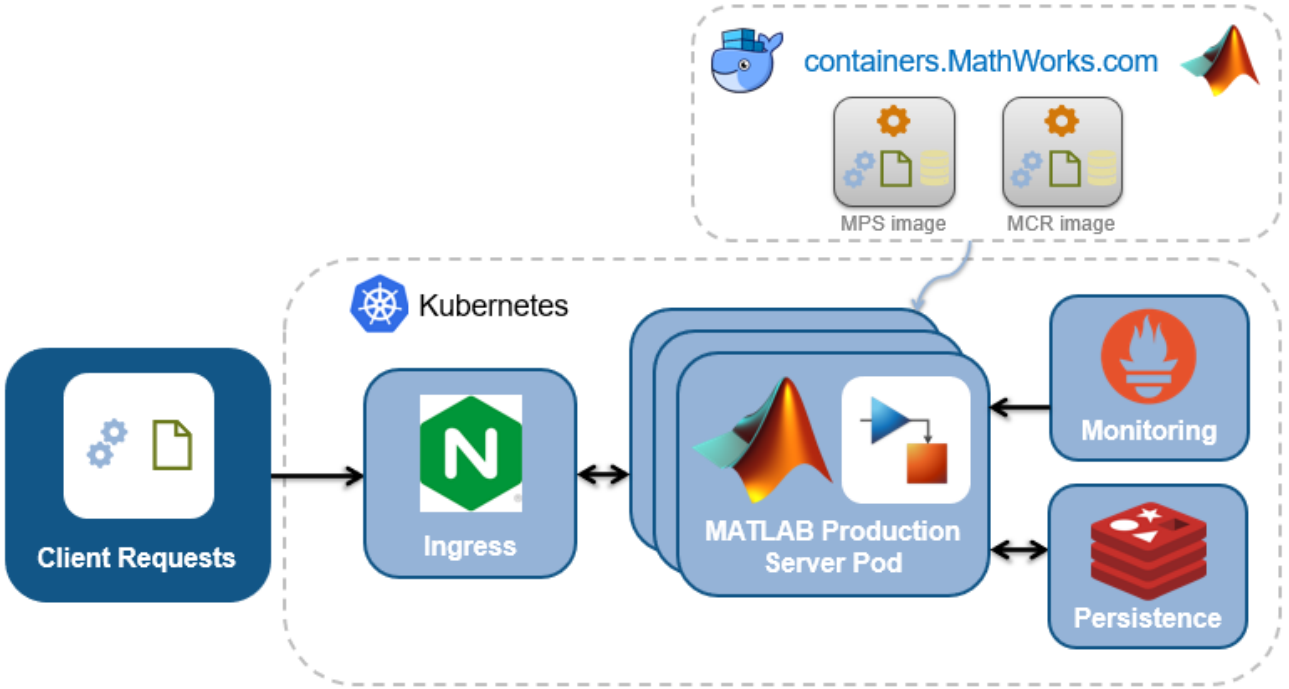
Deploy MATLAB and Simulink algorithms in containers

Turn proof of concepts…



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

Into production web services deployed with DevOps principles



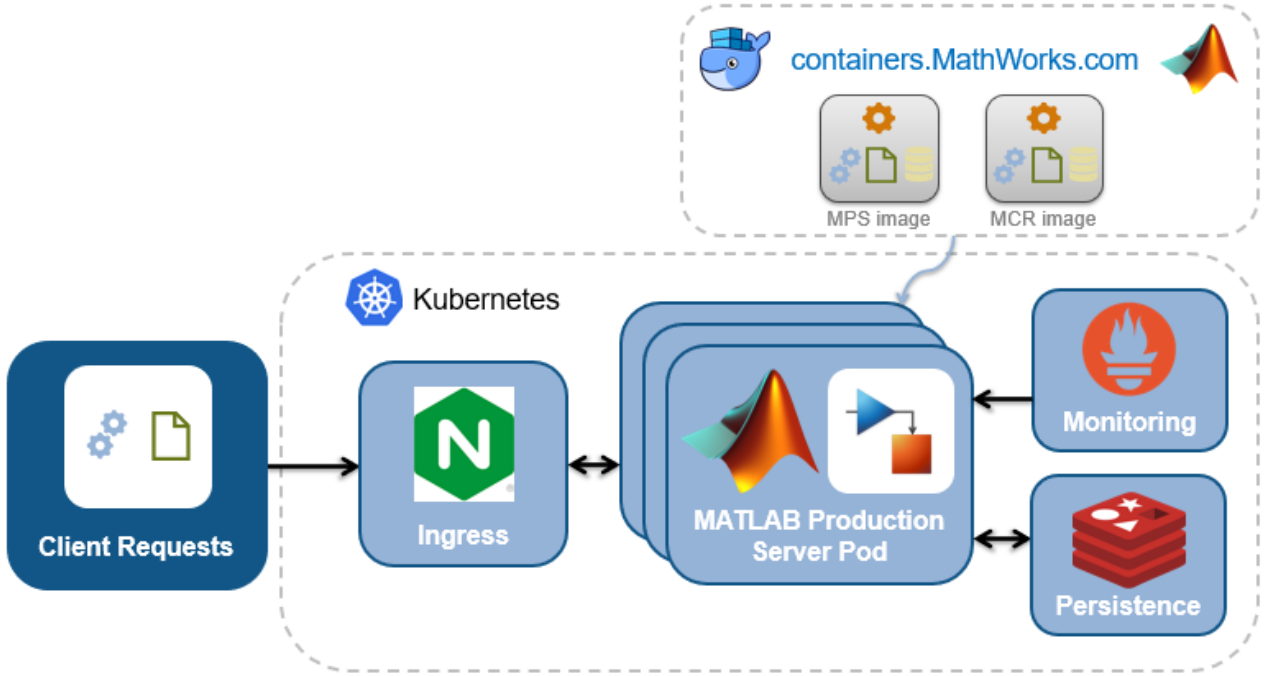
Turn those same MATLAB models and Simulink simulations into production-ready RESTful HTTP endpoint(s) with access control, autoscaling, and more

[Create Microservice Docker Containers with MATLAB]

Deploying to cloud using MATLAB Production Server

Container-based MATLAB Production Server

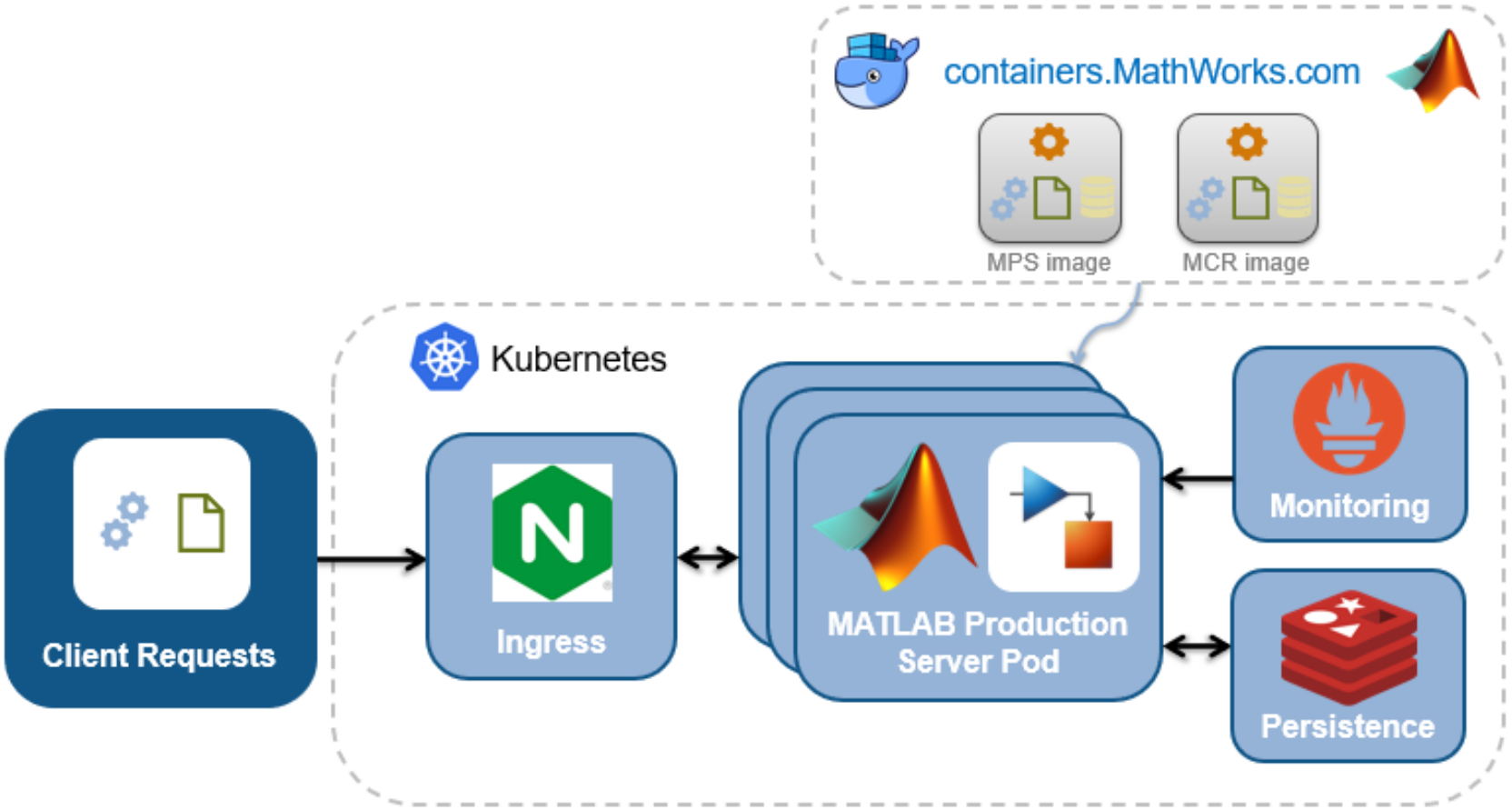
- Any Kubernetes cluster (Vendor independent)
- Lightweight, lower upfront infrastructure cost (New pods can be started quickly)
- Linux only
- Autoscaling
- CLI configuration



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

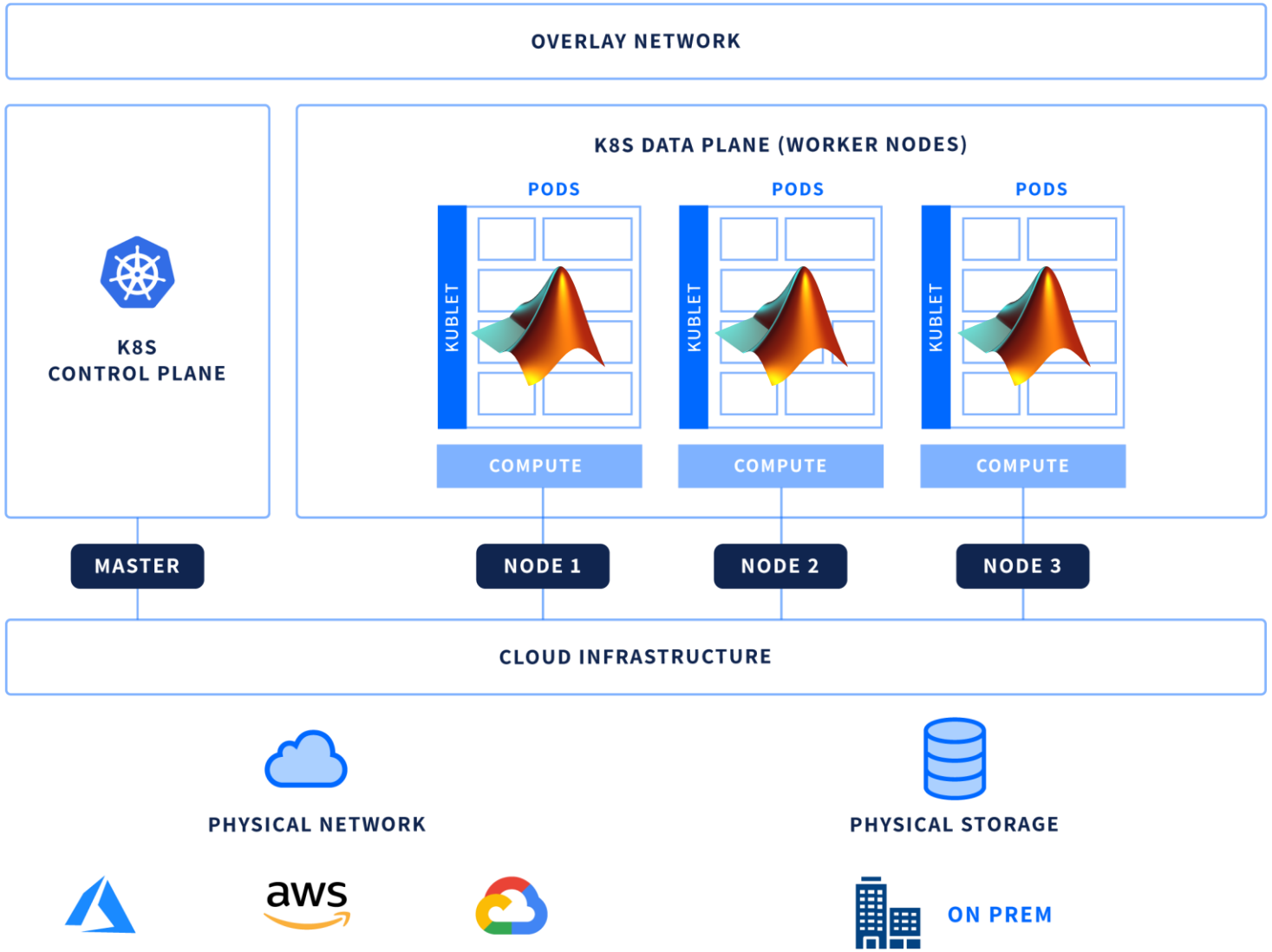
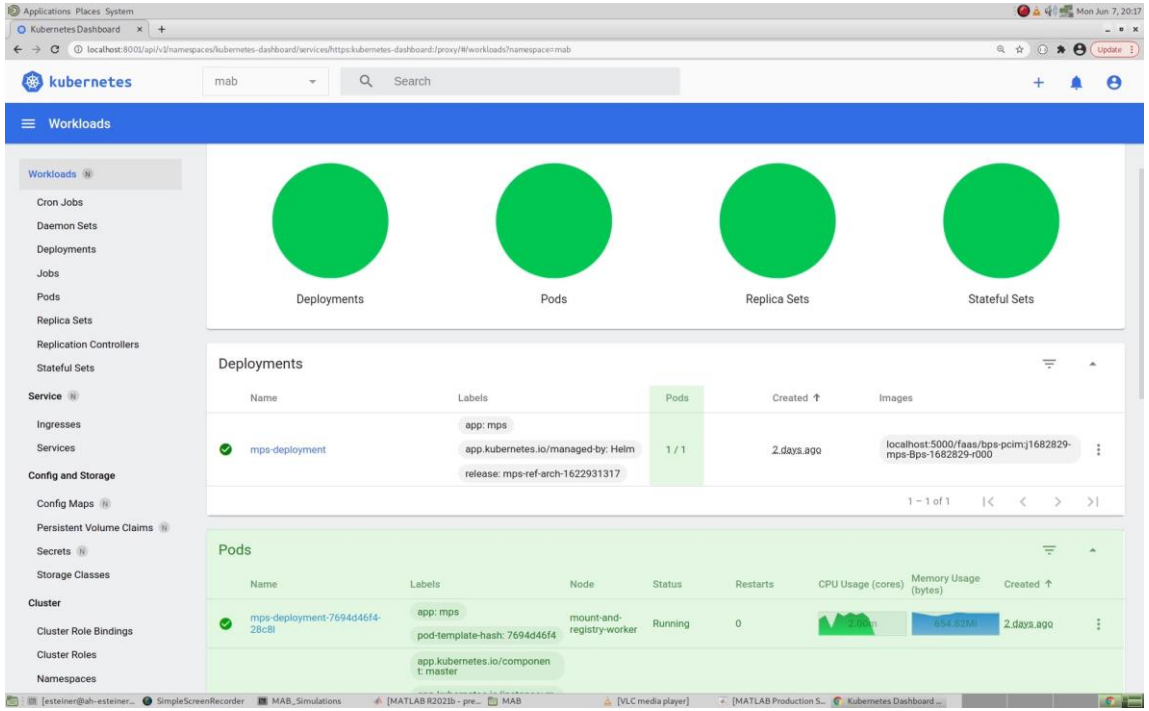


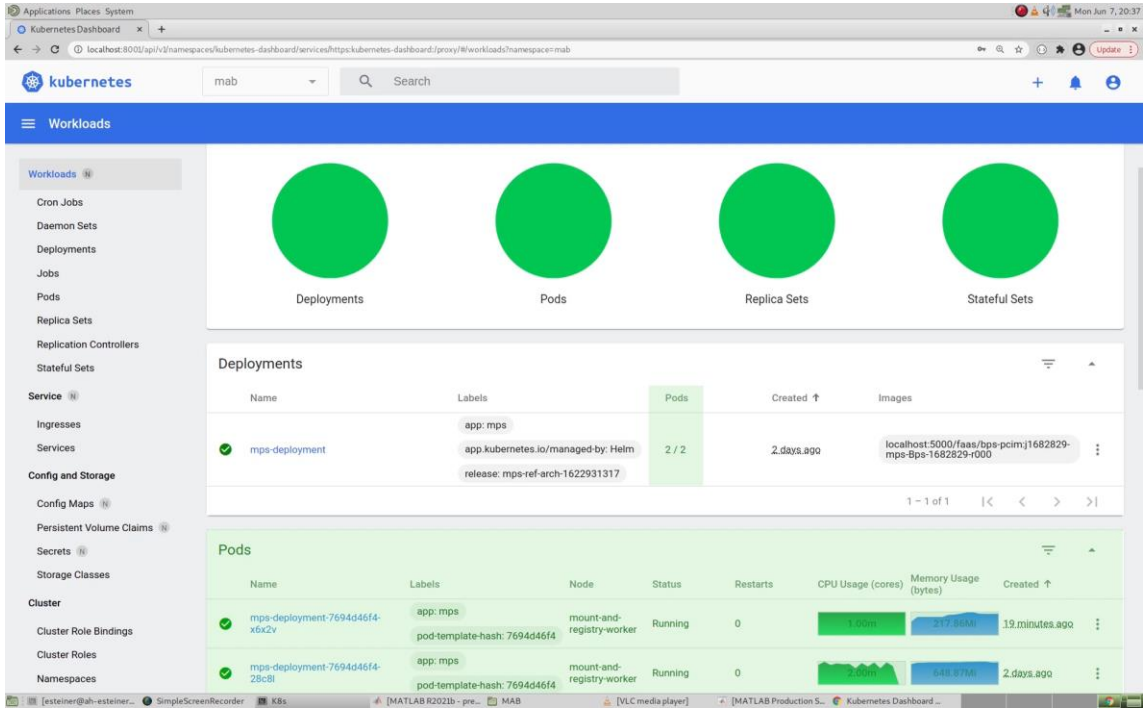
Image source: https://spot.io/blog/above-all-clouds-orchestrating-and-managing-kubernetes-across-cloud-and-on-premises

Kubernetes autoscaling based on requests

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



Adding resources



Removing resources

Deploying K8s hosted MATLAB Production Server

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

Azure

Which cloud architecture should we use?

We have integrations that require Windows-based software

Process Engineer

Develops models in MATLAB and Simulink

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

System Architect

Deploys and operationalizes models on Azure cloud

Azure

Key Takeaways

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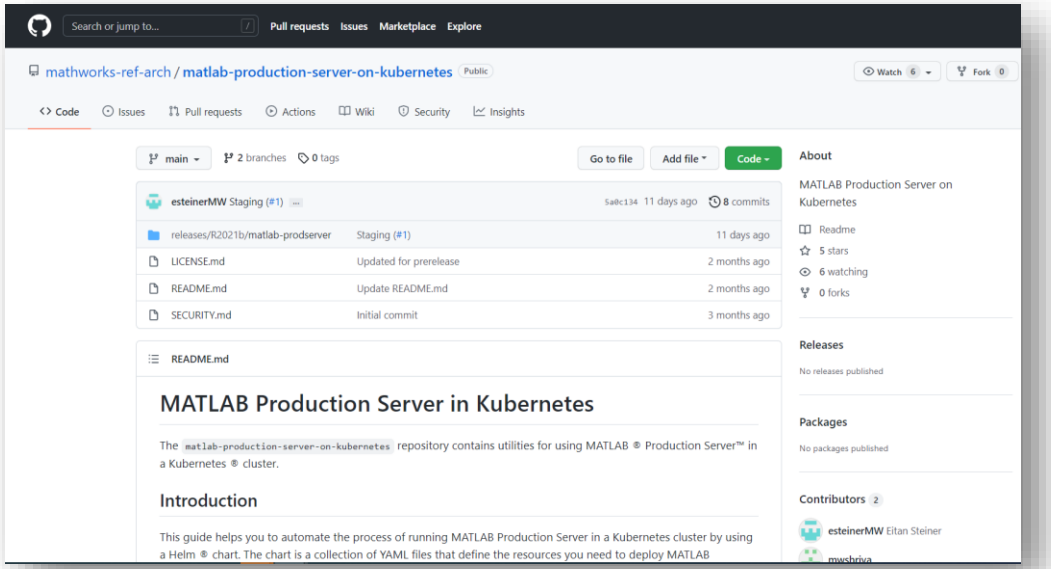
Call to Action

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

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Thank you

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