SOAFEE

Porting the SOAFEE AVP Blueprint to a China Cloud

A Practical Migration Journey

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NOV 12, 2025

What is the SOAFEE AVP Blueprint?

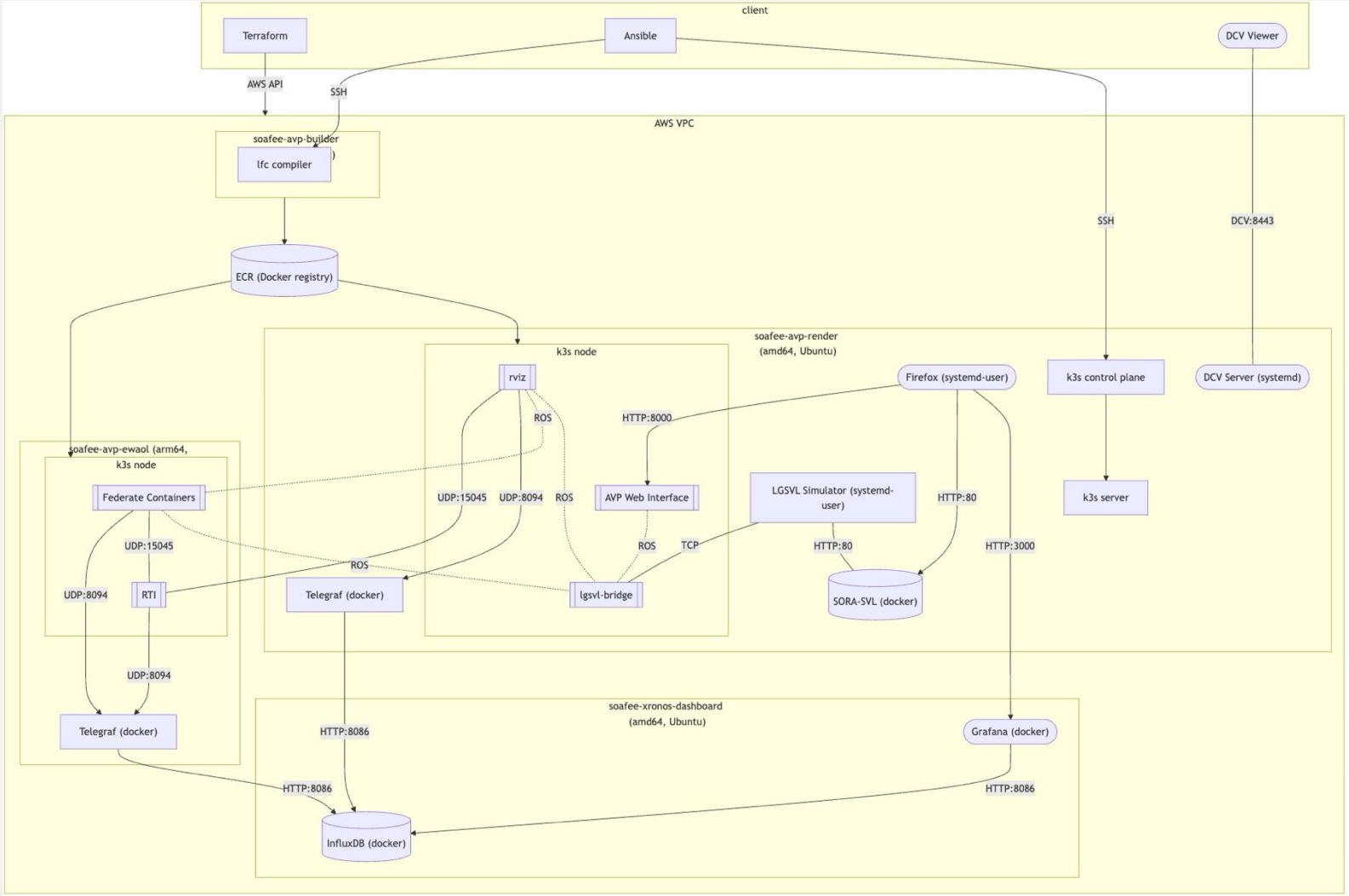
AVP Blueprint Overview

Originally developed by DENSO as an open reference blueprint for the SOAFEE community.

- Hosted at:
  - https://github.com/DensoSVIC/soafee-avp-blueprint
- Demonstrates a complete Autonomous Valet Parking (AVP) scenario built on the SOAFEE architecture.
- Implements cloud-native principles for automotive workloads:
  - Modular containerized federates
  - Real-time Linux and mixed-critical orchestration
  - Edge-cloud collaboration through k3s orchestration
- Designed to run on both arm64 and x86_64 nodes
  - Showcasing SOAFEE's cross-architecture flexibility.
- Serves as the reference for deploying, testing, and extending automotive workloads using SOAFEE.

AVP Blueprint Architecture

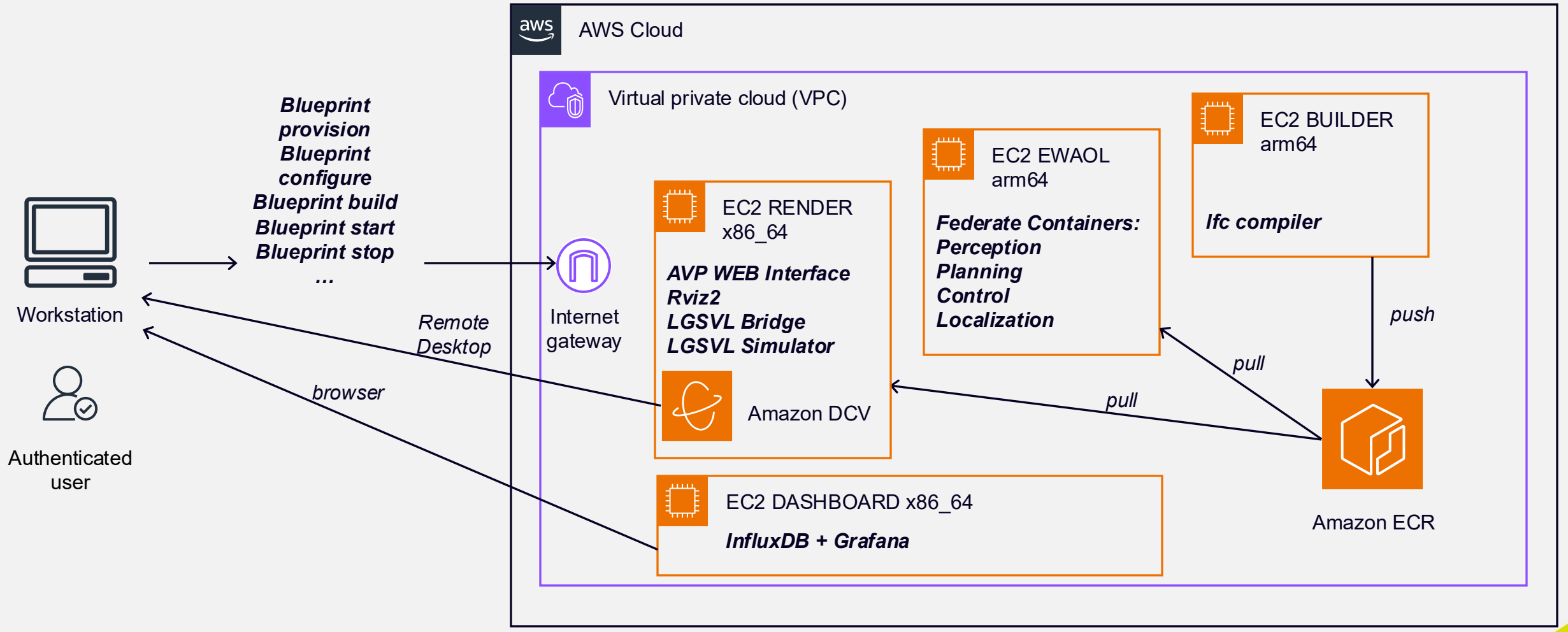
AVP Blueprint Overview



- IaC & Provisioning:
  - Terraform and Ansible.
- Image Supply:
  - Builder compiles AVP components.
  - Pushes versioned images to ECR.
- Orchestration & Simulation:
  - k3s control plane schedules AVP pods.
  - LGSVL + SORA-SVL run parking scenarios.
- ROS & Application Interfaces:
  - Bridge + rviz + AVP Web UI.
- Real-Time & Heterogeneous:
  - ARM node runs federated / RTI modules.
- Observability & Remote Access:
  - Telegraf → InfluxDB → Grafana dashboards;
  - NICE DCV streams 3D & UI to developer.

Original AWS Stack Components

SOAFEE AVP Blueprint Overview



AVP Blueprint Deployment on AWS

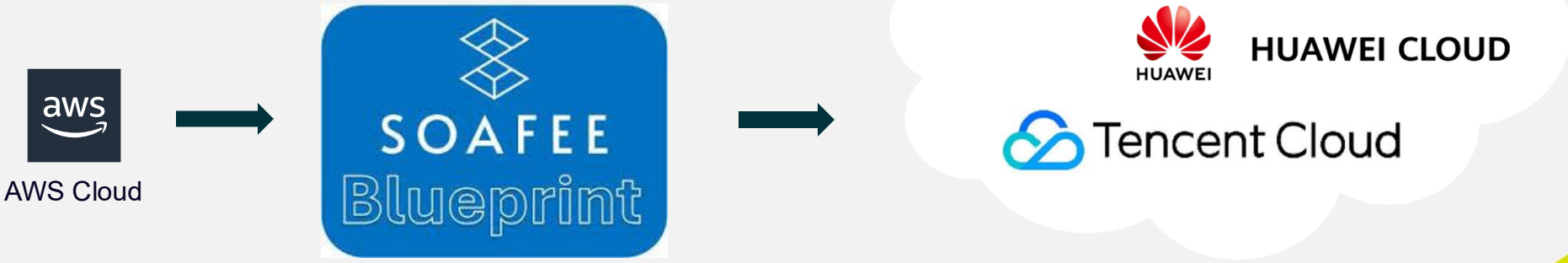
AVP Blueprint Overview

Name	Instance Type	Role	Description
EC2-RENDER	• g5.4xlarge, x86_64 • CPU: 16 • MEM: 64 GB	• SOAFEE Orchestrator • AVP Simulator • Web Interface • Telegraf agent	SOAFEE Orchestrator (k3s Master): - Manages AVP containers across nodes - Deploys workloads using k3s AVP Simulator (LGSVL) - Simulates parking environment - Publishes sensor data to federate pods Web Interface + RViz2 - User-facing GUI / Visualization of AVP simulator
EC2-EWAOL	• t4g.2xlarge, arm64 • CPU: 8 • MEM: 32 GB	• AVP workloads • Telegraf agent	AVP workloads (Federate arm64 Containers): - Perception: Lidar fusion, object detection - Localization: NDT map, robot-state-publisher - Planning: Global planner, lane planner - Control: MPC controller, behavior planner
EC2-DASHBOARD	• t3.xlarge, x86_64 • CPU: 4 • MEM: 16 GB	• Dashboard • Monitoring Services	Monitoring Services: - InfluxDB - Telegraf agents collect metrics Dashboard Services: - Grafana
EC2-BUILDER	• t4g.2xlarge, arm64 • CPU: 8 • MEM: 32 GB	• Ifc build machine	- Used to build arm64 container images during setup - Idle during runtime

Why Migrate the AVP Blueprint (AWS → China Cloud)

Drivers (Pain Points / Needs)

- Compliance & Data Sovereignty:
  - Meet local security / MLPS, cryptography, filing & audit requirements.
- Multi-Cloud Sustainability:
  - Avoid lock-in, build a decentralized, portable deployment strategy.
- Cost & Supply Chain Control:
  - Reduce reliance on overseas services.
  - Improve delivery controllability & risk mitigation.
- Technical Validation:
  - Prove SOAFEE architecture portability and behavioral consistency.
- User Experience & Latency:
  - Current AWS access from our target region suffers high RTT.



Core Objectives of the Migration

Portability, Parity, and Enhanced Developer Experience

- Minimal Code & Config Change
  - Transfer cloud-specific differences into Terraform modules & Ansible roles
  - Keep AVP application logic and scenario behavior untouched
- Performance Parity
  - Maintain startup time & perception inference latency close to the original AWS baseline
  - Keep container lifecycle stability close to the original AWS baseline
- Standardized Automation Pipeline
  - One reproducible Terraform + Ansible workflow
  - Enables one-command provisioning and prevents environment drift
- Improved Interactive User Experience
  - Lower remote visualization latency (DCV/VNC) and accelerate image pulls
  - Smooth control feedback loop for more responsive simulation & debugging

Overall Migration Strategy

- **Strategy Principles:**

Isomorphic First

Abstraction Upwards

Image Localization

Reversible Deployment

Migration Phases:

- Cloud resource selection & account compliance preparation
- Terraform provider & module adaptation
- Base image & container registry localization
- Network & security tuning
- Ansible playbook parameter & role adjustments
- AVP application layer adaptation
- Integration testing
- Demo environment deployment & graphical access verification

Core Replacement Mapping (AWS → China Cloud)

Migration Workflow

Layer / Function	AWS Service / Component	China Cloud Equivalent	Migration Action
Compute Nodes	EC2 (x86 / ARM)	ECS (x86, ARM)	Instance type mapping & sizing
GPU / Rendering	NVIDIA GRID	NVIDIA A10	VNC stack
Virtual Network	VPC + Subnets	VPC + VSwitch	Terraform module rewrite
Security Boundary	Security Groups	Security Groups	Direct mapping
Public Exposure / NAT	NAT Gateway	NAT Gateway	Module swap
Elastic IP	Elastic IP (EIP)	EIP	Direct mapping
Internal DNS	Route 53	Private Zone	Re-point zone configs
Block Storage	EBS (gp3 / io2)	ESSD (PL0–PL3)	Storage class mapping
Object Storage (if used)	S3	OSS	Adjust endpoints & credentials
Container Registry	ECR	ACR	Mirror + re-tag Push multi-arch
Identity & Access	IAM Roles / Policies	RAM Roles / Policies	Map permissions Assume-role logic
Remote GUI	NICE DCV	x11VNC	Install & optimize

Compute & Architecture Mapping

EC2 → ECS Instance Transition

	AWS				China Cloud			
Role	AWS EC2 Type	vCPU	Memory	CPU / GPU	New ECS Type	vCPU	Memory	CPU / GPU
RENDER	g5.4xlarge (x86_64)	16	64 GB	NVIDIA GRID	ecs.gn7i-c16g1.4xlarge (x86_64)	16	60 GB	NVIDIA A10
EWAOL	t4g.2xlarge (arm64)	8	32 GB	ARM64 Neoverse	ecs.g6r.2xlarge (arm64)	8	32 GB	ARM64 Neoverse
DASHBOARD	t3.xlarge (x86_64)	4	16 GB	General Purpose	ecs.g9i.xlarge (x86_64)	4	16 GB	General Purpose
BUILDER	t4g.2xlarge (arm64)	8	32 GB	ARM64 Neoverse	ecs.g6r.4xlarge (arm64)	16	64 GB	ARM64 Neoverse

Terraform Layer Adaptation

Highlights

- Provider / Credential Localization
- Networking & Core Infra
- VPC + VSwitch (public/private) recreated
  - Security Group rule model fixed
  - Instance Mapping & Normalization
- Identity and Access Management Adaptation
  - AWS AMIs → Resource and Access Management
- Container Registry
  - AWS ECR → China Cloud Container Registry
- IAM Adaptation
  - AWS IAM → China Cloud Role
- Security Group Rule Refactor

Ansible Playbooks Adjustments

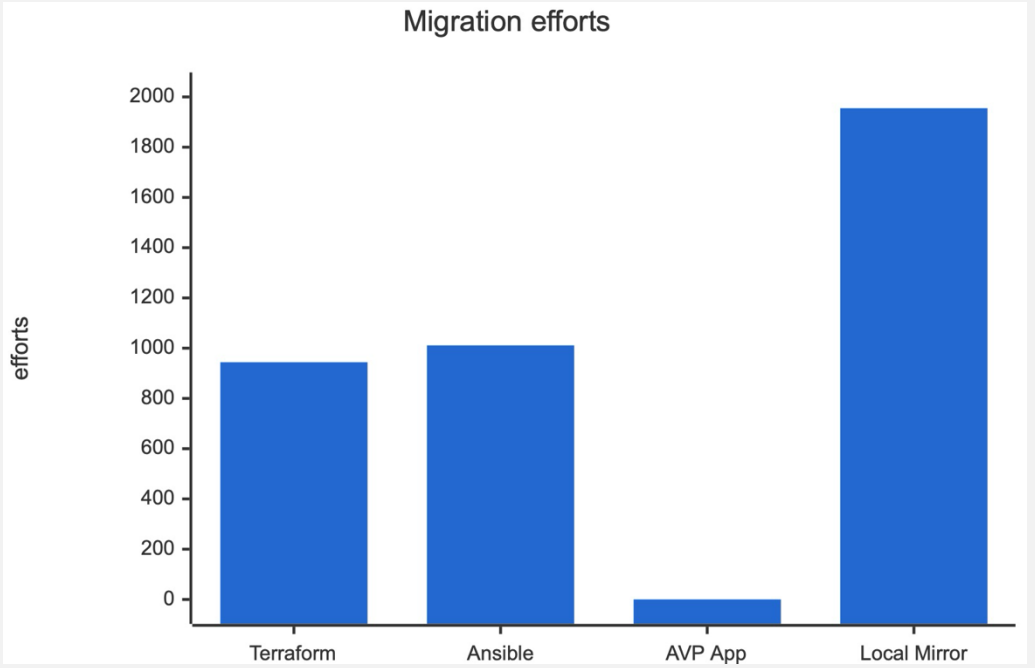
Highlights

- Cloud Toolchain & Provider Shift
  - AWS CLI → China Cloud provider CLI.
- Container Registry Authentication Adaptation
  - Add new login flow for China Cloud provider.
- GPU & Visualization Stack Adaptation
  - NVIDIA driver role parameters changed.
  - New display detection logic and VNC service.
- User / System Differences
  - Default ansible_user mappings and disk size adjustment.
- Image & Build Pipeline Adjustments
  - Container pulls switched to Local Container Registry.
- Source Assets & Demo Repository
  - AWS S3 & GITHUB → China Local Storage Provider.

Porting Challenges and Solutions

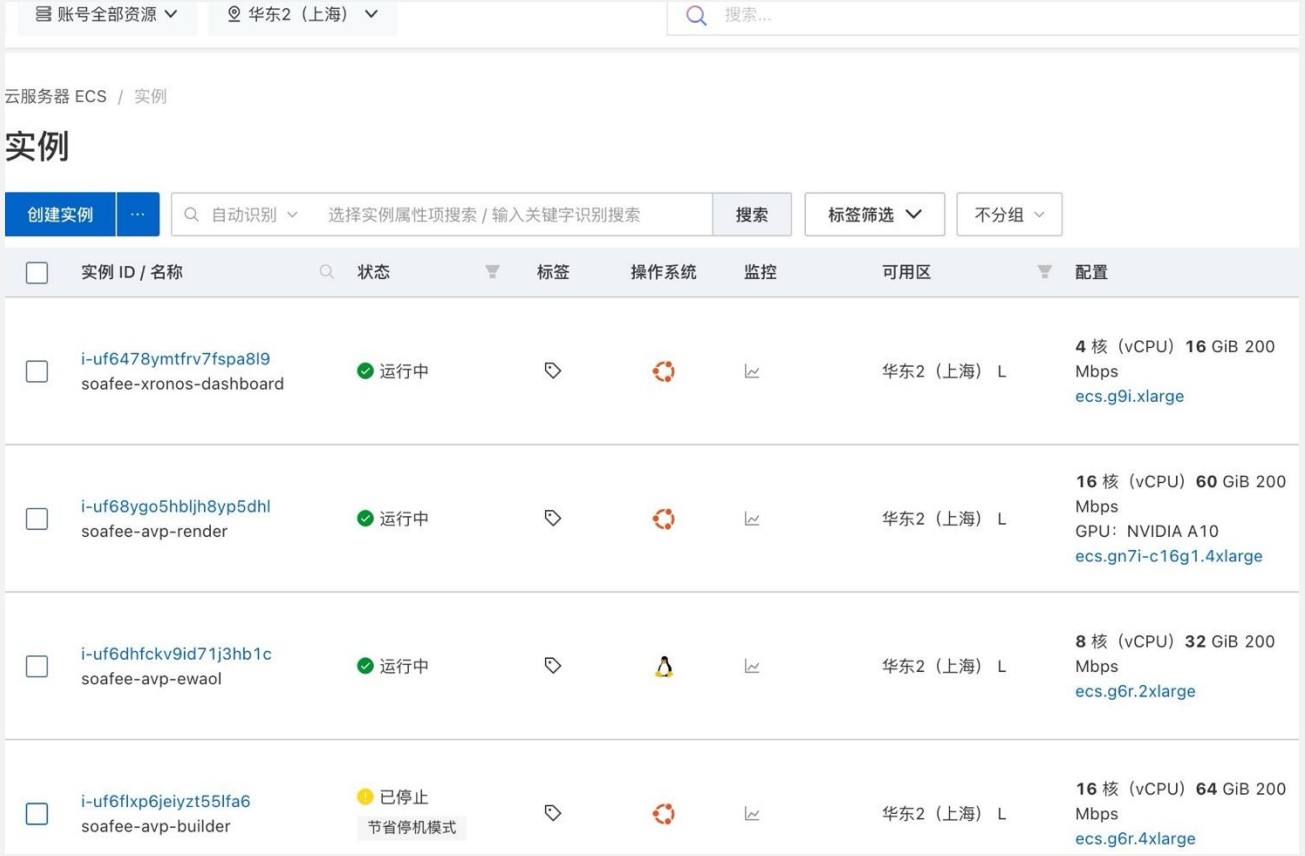
Challenges, Solutions and Efforts

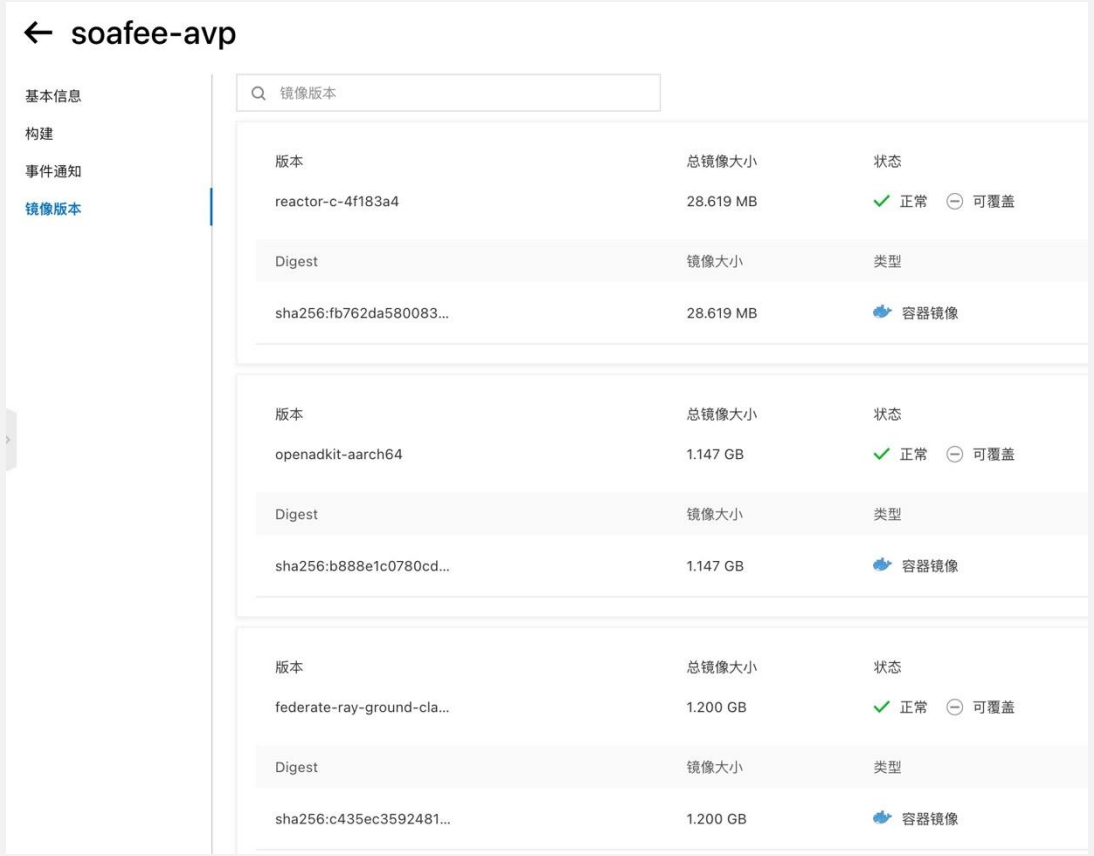
Category	Challenge	Solution
Cloud Infrastructure	Insufficient GPU quota	Early quota & capacity audit; pre-request GPU quota (A10/Tesla) before bulk provisioning
Networking	Network & Dependency Access During Configure / Build	Mirroring, proxy, S3 Asset Re-hosting
Docker Registry	Unable to access DockerHub/ECR images or high latency	Mirrored required images to local container registry



Demo: AVP on China Cloud

Provision, Configure and Build

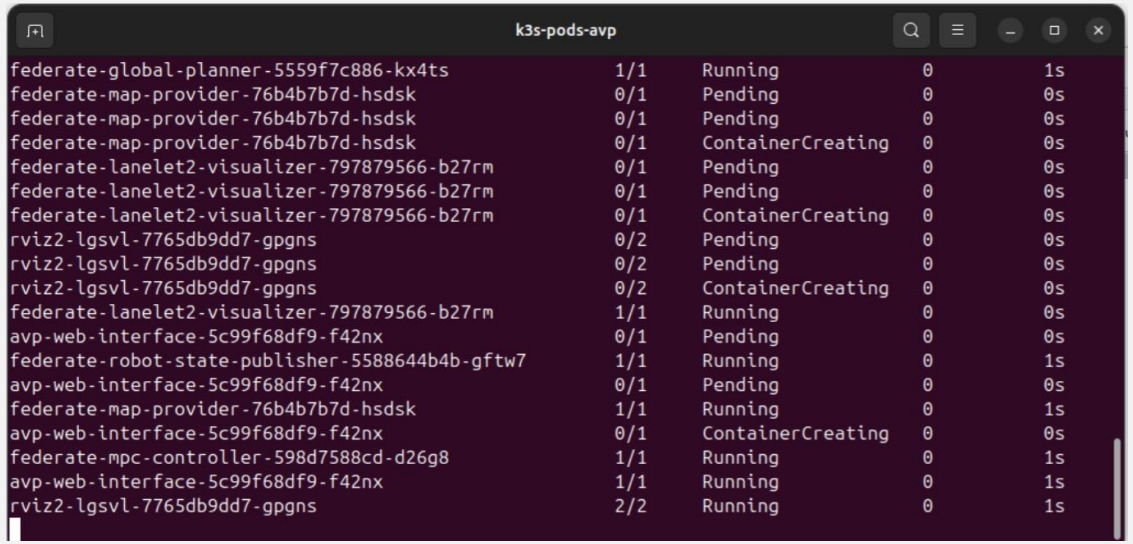


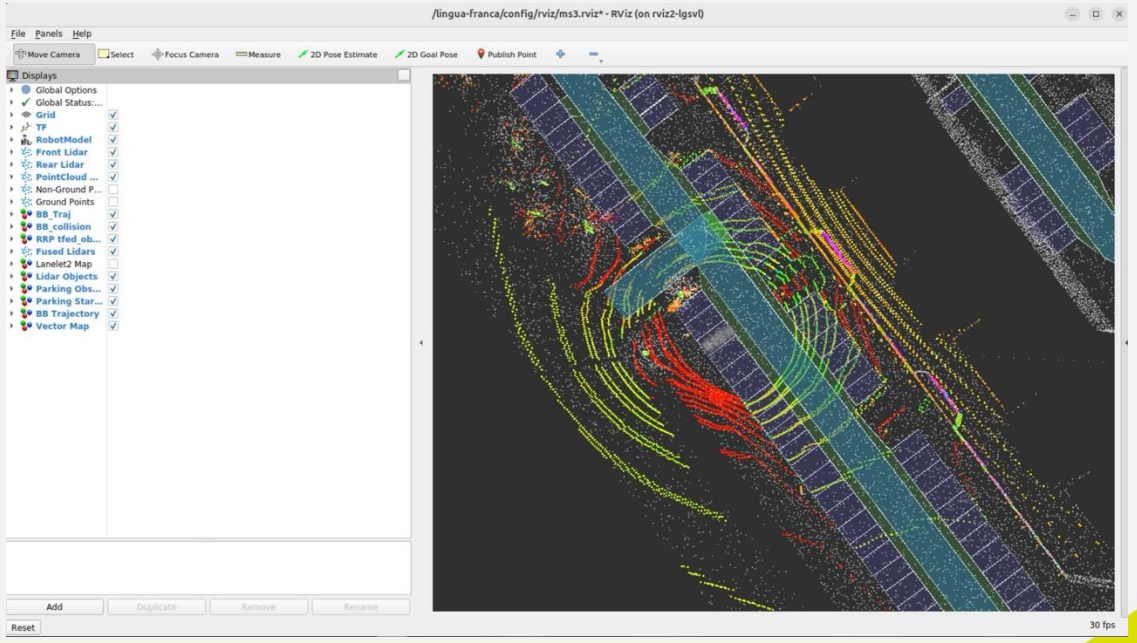


Demo: AVP on China Cloud

Start SOAFEE Blueprint on China Cloud

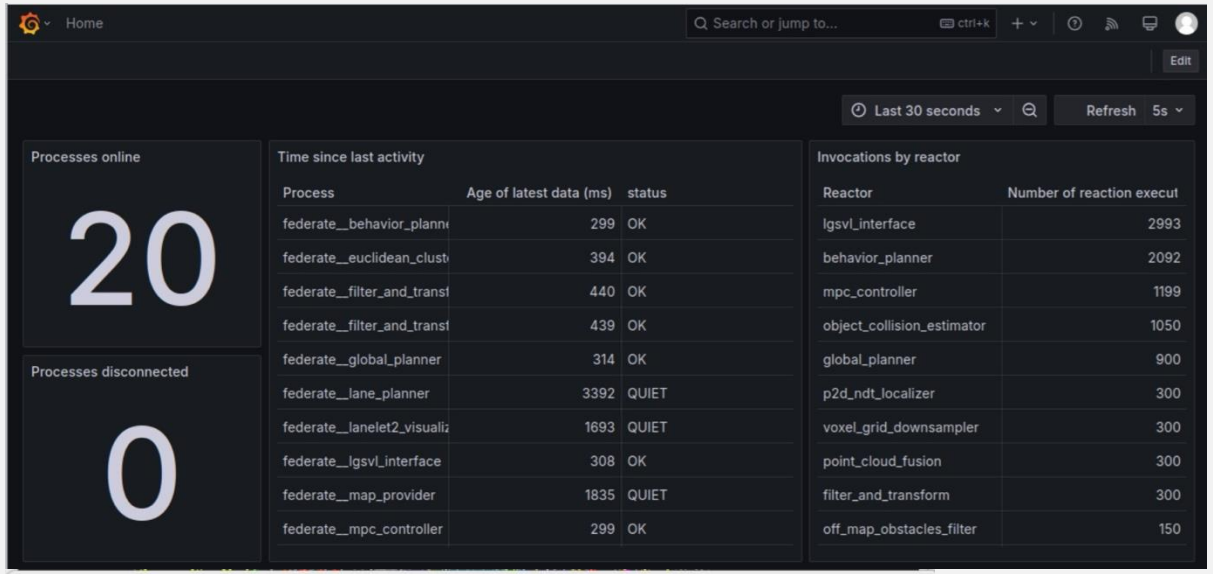
```
weic@ais-wip-ds:~/soafee-avp-blueprint$ ./blueprint start

SOAFEE Blueprint - Autonomous Valet Parking Demo
    by DENSO International America, Inc.

active configuration:
-----------
command:        start
command args:
deployment:     soafee
active user:    avp
active keyfile: soafee-avp.pem
ssh agent:
volumes:        --volume xronos-ansible-cache-roles:/usr/share/ansible/roles
                --volume xronos-ansible-cache-collections:/usr/share/ansible/collections
                --volume xronos-soafee-instances:/home/ubuntu/instances:ro
ansible args:   TASK [start : k3s wait for pods] ***************************************************
                ok: [soafee-avp-render] => (item=rti)
                ok: [soafee-avp-render] => (item=federate-filter-and-transform-0)
                ok: [soafee-avp-render] => (item=federate-filter-and-transform-1)
                ok: [soafee-avp-render] => (item=federate-point-cloud-fusion)
                ok: [soafee-avp-render] => (item=federate-voxel-grid-downsampler)
===> running AVP ok: [soafee-avp-render] => (item=federate-ray-ground-classifier)
                ok: [soafee-avp-render] => (item=federate-euclidean-cluster-detector)
                ok: [soafee-avp-render] => (item=federate-ndt-map-publisher)
                ok: [soafee-avp-render] => (item=federate-p2d-ndt-localizer)
                ok: [soafee-avp-render] => (item=federate-off-map-obstacles-filter)
                ok: [soafee-avp-render] => (item=federate-behavior-planner)
                ok: [soafee-avp-render] => (item=federate-parking-planner)
                ok: [soafee-avp-render] => (item=federate-lane-planner)
                ok: [soafee-avp-render] => (item=federate-global-planner)
                ok: [soafee-avp-render] => (item=federate-object-collision-estimator)
                ok: [soafee-avp-render]
                ok: [soafee-avp-render]
                ok: [soafee-avp-render]
                ok: [soafee-avp-render]
                ok: [soafee-avp-render]
                ok: [soafee-avp-render]
                ok: [soafee-avp-render]

TASK [start : Set websocket bind address 10.43.67.68 in avp-web-interface] *************
changed: [soafee-avp-render]

TASK [start : Open SORA-SVL web interface in Firefox] **********************************
changed: [soafee-avp-render]

TASK [start : Open SORA-SVL docs in Firefox] ***************************************
changed: [soafee-avp-render]

TASK [start : Open avp-web-interface in Firefox] ***********************************
changed: [soafee-avp-render]

TASK [start : Open Grafana in Firefox] *********************************************
changed: [soafee-avp-render]

PLAY RECAP *************************************************************************
soafee-avp-render          : ok=32   changed=12   unreachable=0    failed=0    skipped=3

===> AVP demo command 'start' complete
```

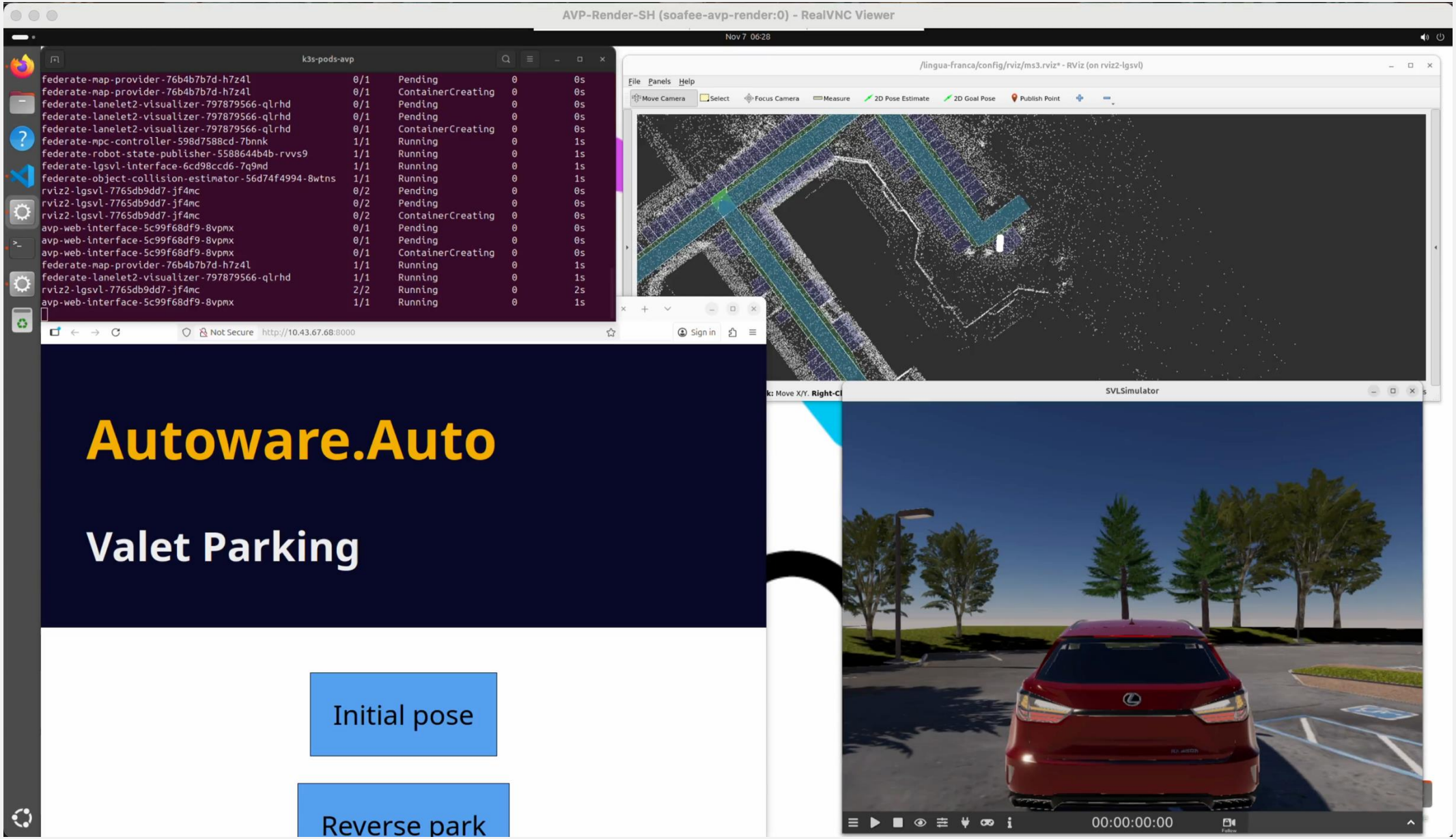




Demo: AVP on China Cloud

Start SOAFEE Blueprint on China Cloud




AVP-Render-SH (soafee-avp-render:0) - RealVNC Viewer
Nov 7 06:28
k3s-pods-avp
federate-map-provider-76b4b7b7d-h7z4l 0/1 Pending 0 0s
federate-map-provider-76b4b7b7d-h7z4l 0/1 ContainerCreating 0 0s
federate-lanelet2-visualizer-797879566-qlrhd 0/1 Pending 0 0s
federate-lanelet2-visualizer-797879566-qlrhd 0/1 Pending 0 0s
federate-lanelet2-visualizer-797879566-qlrhd 0/1 ContainerCreating 0 0s
federate-mpc-controller-598d7588cd-7bnnk 1/1 Running 0 1s
federate-robot-state-publisher-5588644b4b-rvvs9 1/1 Running 0 1s
federate-lgsvl-interface-6cd98ccd6-7q9md 1/1 Running 0 1s
federate-object-collision-estimator-56d74f4994-8wtns 1/1 Running 0 1s
rviz2-lgsvl-7765db9dd7-jf4mc 0/2 Pending 0 0s
rviz2-lgsvl-7765db9dd7-jf4mc 0/2 Pending 0 0s
rviz2-lgsvl-7765db9dd7-jf4mc 0/2 ContainerCreating 0 0s
avp-web-interface-5c99f68df9-8vpmx 0/1 Pending 0 0s
avp-web-interface-5c99f68df9-8vpmx 0/1 Pending 0 0s
avp-web-interface-5c99f68df9-8vpmx 0/1 ContainerCreating 0 0s
federate-map-provider-76b4b7b7d-h7z4l 1/1 Running 0 1s
federate-lanelet2-visualizer-797879566-qlrhd 1/1 Running 0 1s
rviz2-lgsvl-7765db9dd7-jf4mc 2/2 Running 0 2s
avp-web-interface-5c99f68df9-8vpmx 1/1 Running 0 1s
/lingua-franca/config/rviz/ms3.rviz* - RViz (on rviz2-lgsvl)
File Panels Help
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Goal Pose
Publish Point
Not Secure http://10.43.67.68:8000
Sign in
Autoware.Auto
Valet Parking
Initial pose
Reverse park
SVLSimulator
00:00:00:00

Outcomes & Reusable Assets

- Validated Cross-Cloud SOAFEE Abstraction
  - Container orchestration and workload deployment migrated with zero application logic intrusion.
- Repeatable, Compliance-Ready Blueprint
  - A template that accelerates future regional rollouts and shortens localization lead time.
- Localized Image & Automation Supply Chain
  - Enterprise registry mirroring + automated build/sign pipeline improves reliability and reduces cross-border risk.
- Foundation for Multi-Cloud / Edge Collaboration
  - Unified IaC + automation patterns enable future hybrid scenarios and edge node extension.

SOAFEE

Thank You