

CMPE 273 Enterprise Distributed Systems Hackathon

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Enterprise Distributed Systems COE - SRE AI & Agentic Hackathon

This hackathon demonstrates Tier-0 Enterprise Reliability Engineering principles through a simulated global application environment. After completing the Enterprise Software Technologies Program at San José State University, you joined a Fortune 500 organization operating mission-critical applications that demand 99.99999% (seven-nines) availability. The initiative centers on designing, deploying, and validating a Tier-0-class application that integrates real-time IoT telemetry, active user monitoring, and AI-driven visual intelligence across geographically distributed sites. Through the simulation, you will apply high-availability architecture, message-driven data ingestion, and cognitive analytics to ensure operational continuity and reliability at enterprise scale.

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After successfully completing the prestigious Enterprise Software Technologies program at San José State University, you joined a leading Fortune 500 company that operates globally with mission-critical applications classified under Tier-0 availability.

According to the organization's enterprise reliability standards, Tier-0 systems represent the most critical category—applications supporting essential services such as credit-card transaction processing or emergency (911) response systems.

In this context, your assigned application supports real-time user access through a centralized Redis cache datastore, maintaining active status and telemetry data from IoT devices connected via MQTT. These devices include field-level sensors such as gas turbines and drilling bits, continuously publishing data through MQTT topics. The Service-Level Agreement (SLA) for Tier-0 applications mandates 99.99999% (seven-nines) uptime and reliability.

Tier Classification and Recovery Objectives

The enterprise follows a structured **tier-based application availability model**:

Tier	Definition	Recovery Time Objective (RTO)
Tier-0	Mission-critical systems (e.g., 911, payments, industrial control)	Continuous availability (99.99999%)
Tier-1	High-priority business services	Recovery within 1 hour
Tier-2	Important but non-critical services	Recovery within 1 day
Tier-3	Standard or low-priority services	Recovery within 3 days

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You are now tasked with architecting and deploying the Tier-0 version of the target application. Before obtaining executive approval, you intend to simulate enterprise reliability tests and validate that all high-availability (HA) and disaster-recovery (DR) objectives are met.

Device Data

MQTT

Oil & Gas MQTT Simulation: Simulate 100,000 Oil & Gas field devices publishing telemetry to site MQTT topics. Device classes include Turbines, Thermal Engines, Electrical Rotors, and Oil & Gas Connected Devices. Messages follow a consistent schema for reliable ingestion and monitoring.

Since the company has worldwide presence, for hackathon, limit sites to 10.

Topic convention

og/field/{site_id}/{device_type}/{device_id}

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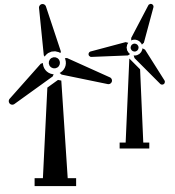
```
{  
  "device_id": "string",  
  "device_type": "string",  
  "site_id": "string",  
  "timestamp_utc": "ISO-8601",  
  "firmware": "string",  
  "metrics": { "key": "number ..." },  
  "status": { "state": "OK|WARN|ALERT", "code": "string", "message": "string" },  
  "location": { "lat": 0.0, "lon": 0.0 },  
  "tags": { "key": "value" }  
}
```

Sample payloads (one per device type) : Turbine

Topic: og/field/WY-ALPHA/turbine/TURB-00912

```
{  
  "device_id": "TURB-00912",  
  "device_type": "turbine",  
  "site_id": "WY-ALPHA",  
  "timestamp_utc": "2025-11-15T23:10:05Z",  
  "firmware": "3.2.1",  
  "metrics": {  
    "rpm": 3487,  
    "inlet_temp_c": 412.6,  
    "exhaust_temp_c": 532.4,  
    "vibration_mm_s": 2.1,  
    "pressure_bar": 17.8,  
    "power_kw": 12850.4,  
    "fuel_flow_kg_h": 420.7,  
    "no_x_ppm": 34.2  
  },  
  "status": { "state": "OK", "code": "TURB-OK", "message": "Nominal" },  
  "location": { "lat": 43.4231, "lon": -106.3148 },  
  "tags": { "vendor": "HanTech", "loop": "A1" }  
}
```

Generate at the sample
rate 1 second



Sample payloads (one per device type) : Thermal Engine

Topic: og/field/TX-EAGLE/thermal_engine/THRM-22177

```
{
  "device_id": "THRM-22177",
  "device_type": "thermal_engine",
  "site_id": "TX-EAGLE",
  "timestamp_utc": "2025-11-15T23:10:05Z",
  "firmware": "1.9.0",
  "metrics": {
    "rpm": 1850,
    "coolant_temp_c": 91.3,
    "oil_temp_c": 98.6,
    "oil_pressure_bar": 4.6,
    "load_pct": 72.4,
    "fuel_rate_l_h": 158.2,
    "soot_pct": 0.6
  },
  "status": { "state": "WARN", "code": "OIL-LOW", "message": "Oil pressure trending low" },
  "location": { "lat": 31.2319, "lon": -101.8752 },
  "tags": { "skid": "TE-07", "phase": "commissioned" }
}
```



Generate at the sample
rate 1 second

Sample payloads (one per device type) : Electrical Rotor

Topic: og/field/NM-SAGE/electrical_rotor/EROT-55031

```
{
  "device_id": "EROT-55031",
  "device_type": "electrical_rotor",
  "site_id": "NM-SAGE",
  "timestamp_utc": "2025-11-15T23:10:05Z",
  "firmware": "2.4.5",
  "metrics": {
    "stator_temp_c": 86.9,
    "bearing_temp_c": 74.1,
    "current_a": 312.5,
    "voltage_v": 416.0,
    "power_factor": 0.94,
    "vibration_mm_s": 1.3
  },
  "status": { "state": "OK", "code": "ER-OK", "message": "Stable" },
  "location": { "lat": 34.4217, "lon": -106.1081 },
  "tags": { "panel": "MCC-2", "line": "R2" }
}
```

Generate at the sample
rate 1 second

Sample payloads (one per device type) : Oil & Gas Connected Device (generic sensor gateway)

Topic: og/field/ND-RAVEN/connected_device/OGC-78402

```
{
  "device_id": "OGC-78402",
  "device_type": "connected_device",
  "site_id": "ND-RAVEN",
  "timestamp_utc": "2025-11-15T23:10:05Z",
  "firmware": "5.0.3",
  "metrics": {
    "wellhead_pressure_bar": 132.7,
    "wellhead_temp_c": 67.4,
    "flow_rate_m3_h": 84.9,
    "methane_leak_ppm": 2.0,
    "battery_soc_pct": 88.0,
    "rssi_dbm": -72
  },
  "status": { "state": "OK", "code": "GW-OK", "message": "All sensors online" },
  "location": { "lat": 48.3992, "lon": -102.7810 },
  "tags": { "network": "LTE", "ingress": "MQTT-1" }
}
```

Generate at the sample
rate 1 second



Users Data:

MQ

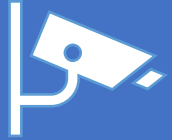
The site simulates active user activity on the web application. The module generates metrics that include: Number of active users currently logged in, Number of active data connections to backend systems, User session list, representing each active user with their session attributes. All this information is transmitted to the site through a message queue (e.g., RabbitMQ) for real-time monitoring and analytics.



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```
{
  "message_id": "MSG-20251115-00123",
  "timestamp_utc": "2025-11-15T23:25:10Z",
  "site_id": "SFO-WEB-01",
  "metrics": {
    "active_users": 324,
    "active_connections": 289,
    "server_cpu_pct": 64.3,
    "server_memory_gb": 18.7,
    "average_latency_ms": 72.4
  },
  "active_users_list": [
    {
      "user_id": "USR-09421",
      "username": "alex_j",
      "session_id": "SESS-342AF1",
      "login_time": "2025-11-15T22:57:44Z",
      "ip_address": "192.168.1.104",
      "region": "US-WEST",
      "connection_status": "active"
    },
    {}
  ]
}
```

```
    "user_id": "USR-11290",
    "username": "maria_k",
    "session_id": "SESS-772B8C",
    "login_time": "2025-11-15T22:59:02Z",
    "ip_address": "10.10.2.56",
    "region": "US-EAST",
    "connection_status": "active"
  },
  {
    "user_id": "USR-00874",
    "username": "chen_li",
    "session_id": "SESS-58E2DA",
    "login_time": "2025-11-15T23:00:18Z",
    "ip_address": "172.16.3.220",
    "region": "APAC",
    "connection_status": "idle"
  }
],
"queue_metadata": {
  "topic": "webapp/active_users",
  "producer": "SiteSimEngine",
  "priority": "normal",
  "retries": 0
}
```



Site Camera Data:

MQ

The site is equipped with security cameras that periodically capture and upload images from various site locations. At the Site Reliability Engineering (SRE) level, these images are processed to enhance operational awareness and automation.

To achieve this, the system applies image-to-embedding conversion using Cohere's embedding models, transforming raw image data into high-dimensional vector representations. These embeddings are then utilized to identify, classify, and generate descriptive insights about the captured images—enabling efficient semantic search, anomaly detection, and contextual monitoring across the site.

You can use a traditional no sql database such as Mongo or In memory cache Redis to have the images and its embeddings.

When user clicks **describe image context, generate word cloud of images that you're seeing on the site. I have uploaded images into Canvas the you can use them to create embeddings. These images are downloaded from the Internet and are owned by respective sites.**





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Device Diagnostics Data:

The data from devices and other IP systems are provided to SRE. You need to use RAG or Code parsing with Code interpreter or AI distributed systems to find which IP is most requested in the logs.

I have uploaded system log



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Enterprise SRE COE - Tier 0 Test Driver

SRE User: ADMIN1

Thank you for visiting the Enterprise Application Reliability Engineering Test Driver to confirm the Low-Tier Verification Test.

SRE User:
Password:

Login

Cancel

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Front End consists of Four buttons: Active Users, Active Devices, Deployment version and Status

Site Active Users : Application retrieves the data from Redis Cache for the logged SRE User. Your cache entries consists of key: SRE_User and Value:JSON with entries number of concurrent users, active users, and curreed logged on users list.

API Contract: ...FASTAPI/region1/getappversion()

Deployment version returns the application version number with region. For example, it returns Tier 0 driver v1.0.0057_region1

JSON output: consist of version: "v1.0.0057_region1"

APIs for Redis Cache Access

APIs for LLM Models

APIs for Cohere Models

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Enterprise SRE COE - Tier 0 Test Driver

SRE User: ADMIN1

Thank you for visiting the Enterprise Application Reliability Engineering Test Driver to confirm the Low-Tier Verification Test.

Application status: Live

Deployment Version

Site Active Users

Active Connected
Devices

Site Image
Intelligence

Simulate Failover

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Enterprise SRE COE - Tier 0 Test Driver

SRE User: ADMIN1

Thank you for visiting the Enterprise Application Reliability Engineering Test Driver to confirm the Low-Tier Verification Test.

Application status: Live

Site version: v1.0.0057_region2

Deployment Version

Site Active Users

Active Connected
Devices

Site Image
Intelligence

Simulate Failover

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Enterprise SRE COE - Tier 0 Test Driver

SRE User: ADMIN1

Thank you for visiting the Enterprise Application Reliability Engineering Test Driver to confirm the Low-Tier Verification Test.

Application status: Live

Site Active Users Data From Cache:

Number of Concurrent Users: NN

Number of Active Sessions: NNN

Users List: Dev User1. Dev User 2

Time since online: 300 seconds, 600 seconds

Simulate High User
Traffic

Randomly generate concurrent users,
active sessions, users (minimum 100
random users and store it in Cache)

Deployment Version

Site Active Users

Active Connected
Devices

Site Image
Intelligence

Simulate Failover

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Enterprise SRE COE - Tier 0 Test Driver

SRE User: ADMIN1

Thank you for visiting the Enterprise Application Reliability Engineering Test Driver to confirm the Low-Tier Verification Test.

Application status: Live

Site Active Devcies Data From MQTT:

Number of Concurrent Devices: NN

Number of Active Sensors: NNN

Sensor Devise List: Turbines, Thermal Engines, Electrical Rotors, and Oil & Gas Connected Devices

Time since online: **300 seconds, 600 seconds**

Deployment Version

Site Active Users

Active Connected
Devices

Site Image
Intelligence

Simulate Failover

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Enterprise SRE COE - Tier 0 Test Driver

SRE User: ADMIN1

Thank you for visiting the Enterprise Application Reliability Engineering Test Driver to confirm the Low-Tier Verification Test.

Application status: Live

Natural Language Query: Give me turbine site that has workers without hats?

Natural Language Query: Give me turbine site that has workers with high safety?

Natural Language Query: Get site with engineer with hat and tablet in the hand?

Deployment Version

Site Active Users

Active Connected
Devices

Site Image
Intelligence

Simulate Failover

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Enterprise SRE COE - Tier 0 Test Driver

SRE User: ADMIN1

Thank you for visiting Enterprise Application Reliability Engineering Test driver for confirming low tier verification test.

Application status: Live ... Stopped ... switch... Live

Application version: v1.0.0057_region1 v1.0.0057_region2

Application Failover time: 0.00n seconds

Deployment Version

Site Active Users

Active Connected
Devices

Site Image
Intelligence

Simulate Failover

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Prompts

- How many safety incidence in BP operations in year 2024?
- Describe BP Oil Drill Operations and Hard Hat requirements.
- Give me most frequent IP devices that are generating error 400?

