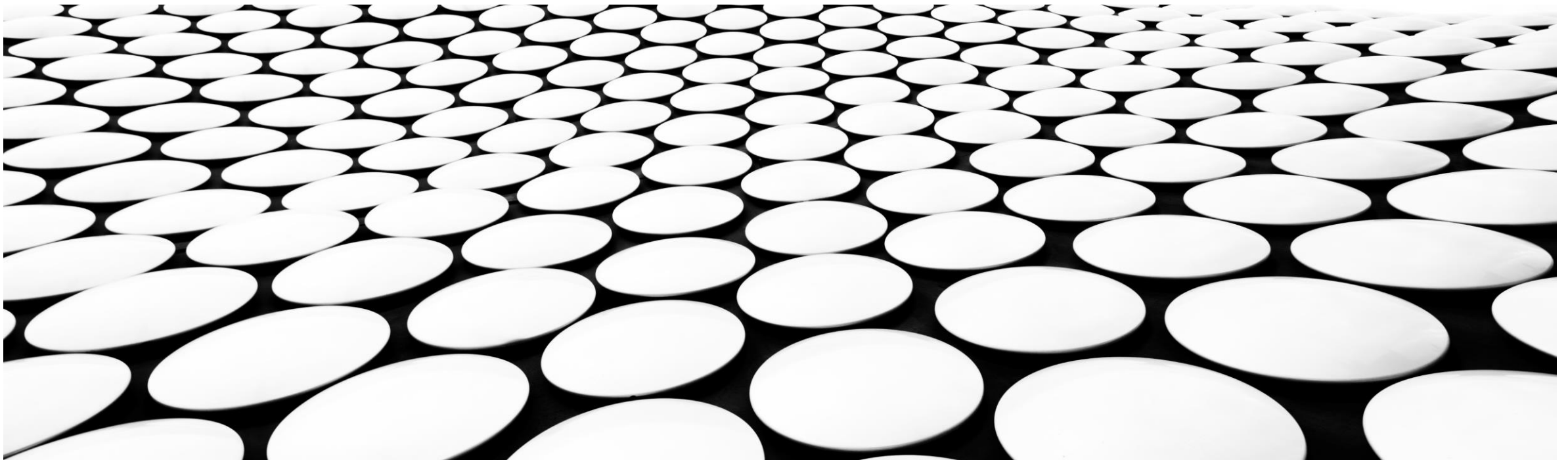


# User interfaces for distributed systems

COEN-317: Distributed Systems  
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# Motivation

## Why develop a Graphical User Interface (GUI) for distributed systems?

### 1. To monitor the distributed system

- Ordinary user may view a queue to determine ETA (estimated time to completion) of tasks.
- Administrative users may view log files and job completion statistics to identify anomalies such as machine failures.
- Developers of distributed systems may monitor the system for testing purposes to diagnose programming errors.

### 2. To manage the distributed system

- Administrative users may override the queue by disabling or suspending jobs manually.

# GUI development for distributed systems: practical advice

## **Suggestions when developing a GUI for distributed systems:**

- Choose a graphical universal interface that is operating system agnostic (i.e. cross platform) and hardware independent.
- Develop multiple levels of user interface functionality in your distributed system: read-only, user, administrator, developer.

# GUI development for distributed systems: practical advice

**There are many choices for GUI toolkit (e.g. Qt, GTK, Java Swing, wxWidgets, etc.).**

- Unfortunately, GUI toolkits can fall behind in development and/or become obscure or no longer supported.

**In my experience, the best route is a web-based (HTML) interface for distributed systems.**

- Web interfaces are quite capable of handling the tasks necessary to monitor and manage a distributed system.
- HTML is well documented, ubiquitous, and backed by a standards committee (W3C).
- HTML support tends to degrade gracefully as the HTML standard evolves.

**For non-web based GUI toolkit, I recommend:**

- Qt

# Web-based GUI: advantages and disadvantages

## **What are the advantages with web-based interfaces?**

- Capable of rendering user-interfaces and content cross-platform on both desktop and mobile devices, tablets, etc.
- Operating system independent
- Hardware independent

## **What are the disadvantages with web-based interfaces?**

- Web-based applications can become unnecessarily complicated with bloated front-end Javascript libraries.
- HTTP is a stateless protocol. You will need to implement some sort of session management to maintain state in sophisticated web-based interfaces.

## **Architectural design considerations for web-based interfaces:**

- All processing split between server-side and client-side.
- All processing conducted one client-side using Javascript and CSS or Java.

# Web-based GUI: Beginning development suggestions

## **When you begin developing web-based user interfaces for distributed systems:**

- Keep the interface sparse.
- Start with a simple, fixed-resolution interface. I suggest implementing the interface on a desktop or tablet display with a large screen. Then test that interface to see if it is comfortable to view and interact with.
- Design the user interface in stages. For example, begin with a read-only interface. Then create a management interface (which would require login functionality authentication).
- Once the interface layout is acceptable, begin designing interfaces for various screen resolutions.
- In time you can make the interface responsive and adjustable to various screen resolutions.

# Web-based GUI: helper libraries

**When developing web-based user interfaces for distributed systems, I recommend the following:**

- Bootstrap

<https://getbootstrap.com/>

- React

<https://reactjs.org/>

- jQuery

<https://jquery.com/>

# What should be implemented in a GUI for distributed systems?

## 1. Job management (manual override)

- Designate a master queue machine (IP address or MAC address)
- Suspend operation of a backup queue machine (IP address or MAC address)
- Resume operation of a backup queue machine (IP address or MAC address)
- Delete pending jobs in master queue (all jobs or specific jobs)
- Delete in-progress jobs in master queue (all jobs or specific jobs)
- Delete error messages (all errors messages or specific error messages)

## 2. Queue monitor (read-only)

- IP address of master queue
- IP addresses of backup queue machine (identified as backup queues in case master queue fails)

## 3. Job statistics: worker machines (read-only)

- Number of pending jobs
- Number of in-progress jobs
- Number of completed jobs
- Number of suspended jobs (possibly due to machine failure)
- Average job completion time (all worker machines)
- Average job completion time (particular worker machine)
- Average CPU utilization (all worker machines)
- Average CPU utilization (particular worker machine)

## 4. Error message statistics: worker machines (read-only)

- Number of error messages reported (all worker machines and queue manager machines)
- Type of error message reported (network failure, drive failure, etc.)



# BOINC interface

Project	Application	Name	Elapsed Time	CPU %	v2 Progress	Time Left	Deadline	Use	Status	Throttle	Temperature	Computer
SETI@home	7.00 setiathome_v7	4 [Tasks], double click to expand	11:14:30 (03:22:47)	30,06	53,900	02:42:52	7/30/2014 6:43:33 PM		Waiting to run			Fred
SETI@home	7.00 setiathome_v7 (cuda50)	2 [Tasks], double click to expand	00:30:18 (00:01:47)	5,93	21,444	01:04:43	8/25/2014 2:59:19 AM	0,04 CPUs + 0,5 NVIDIA GPUs	Waiting to run			Fred
Milkyway@Home	1.30 milkyway_separation_modified_...	ps_modfit_15_3s_130_wrap_const_1_13983363...	00:02:19 (00:00:01)		6,563	00:19:07	7/18/2014 3:45:59 PM	0,279 CPUs + 1 NVIDIA GPU	Running High P.		57,0 °C	Fred
World Community Grid	7.20 fahv	FAHV_x2HC0-1w1n0-AAsh1025_0870489_0296_0	00:02:20 (00:01:09)	42,68	1,214	02:01:45	7/16/2014 3:48:36 PM		Running High P.	61	60,6 °C	Fred
World Community Grid	7.16 faah	faah845190_ZINC08915345_2_x4GW6alNleB_00_0	00:02:20 (00:01:08)	36,98	0,786	02:28:25	7/16/2014 3:46:31 PM		Running High P.	61	60,6 °C	Fred
World Community Grid	7.16 faah	faah845190_ZINC09043411_1_x4GW6alNleB_00_0	00:02:20 (00:01:09)	36,94	0,443	02:28:25	7/16/2014 3:48:36 PM		Running High P.	61	60,6 °C	Fred
World Community Grid	7.16 faah	faah845190_ZINC08934735_1_x4GW6alNleB_00_0	00:02:20 (00:01:09)	36,77	0,440	02:28:25	7/16/2014 3:48:36 PM		Running High P.	61	60,6 °C	Fred
Einstein@Home	1.39 einsteinbinary_BRP5 (BRP5-cuda...	PB0025_008A1_190_0	00:01:02 (00:00:16)	25,49	0,392	03:35:10	7/20/2014 3:45:16 PM	0,2 CPUs + 1 NVIDIA GPU	Waiting to run			Fred
Einstein@Home	1.11 hsgamma_FGRP3 (FGRPopencl-n...	21 [Tasks], double click to expand	- (-)			03d,12:04:54	7/20/2014 3:46:23 PM	1 CPUs + 1 NVIDIA GPU	Ready to start			Fred
Einstein@Home	1.39 einsteinbinary_BRP5 (BRP5-cuda...	9 [Tasks], double click to expand	- (-)			01d,08:25:48	7/20/2014 3:46:23 PM	0,2 CPUs + 1 NVIDIA GPU	Ready to start			Fred
World Community Grid	6.40 cep2	E223469_843_K.23.C20FH13N2.01261726.1.set1...	- (-)			04:41:03	7/16/2014 3:48:36 PM		Ready to start			Fred
SETI@home	7.00 setiathome_v7	96 [Tasks], double click to expand	- (-)			06d,21:43:03	7/27/2014 3:11:01 AM		Ready to start			Fred
SETI@home	7.00 setiathome_v7 (cuda50)	98 [Tasks], double click to expand	- (-)			02d,20:54:06	7/24/2014 9:20:32 PM	0,04 CPUs + 0,5 NVIDIA GPUs	Ready to start			Fred
World Community Grid	7.16 faah	15 [Tasks], double click to expand	- (-)			01d,13:41:15	7/17/2014 12:49:26 PM		Ready to start			Fred
World Community Grid	7.16 faah	39 [Tasks], double click to expand	- (-)			04d,18:05:24	7/17/2014 12:49:26 PM		Downloading			Fred
World Community Grid	7.20 fahv	9 [Tasks], double click to expand	- (-)			18:36:45	7/16/2014 3:48:36 PM		Ready to start			Fred
World Community Grid	7.20 fahv	24 [Tasks], double click to expand	- (-)			02d,01:38:00	7/17/2014 12:49:26 PM		Downloading			Fred
SETI@home	7.00 setiathome_v7	09oc08aa.26743.13156.438086664207.12.142_0	01:32:21 (01:26:17)	93,44	100,000	-	8/27/2014 3:05:18 AM		Ready to report			Boinc
SETI@home	7.00 setiathome_v7 (cuda50)	3 [Tasks], double click to expand	01:00:13 (00:04:24)	7,32	100,000	-	7/27/2014 3:00:21 PM	0,04 CPUs + 0,33 NVIDIA GPUs	Ready to report			Boinc
SETI@home	7.00 setiathome_v7 (cuda50)	20au08ab.13919.17045.438086664204.12.88_0	00:21:39 (00:01:34)	7,76	90,400	00:02:12	8/28/2014 2:14:35 PM	0,04 CPUs + 0,33 NVIDIA GPUs (device 0)	Running		62,7 °C	Boinc
SETI@home	7.00 setiathome_v7 (cuda50)	20au08ab.13919.17045.438086664204.12.77_0	00:14:30 (00:01:18)	8,65	47,700	00:10:32	8/28/2014 2:14:35 PM	0,04 CPUs + 0,33 NVIDIA GPUs (device 1)	Running		80,0 °C	Boinc
SETI@home	7.00 setiathome_v7 (cuda50)	20au08ab.13919.19499.438086664204.12.13_0	00:12:38 (00:01:08)	8,61	38,224	00:12:13	8/28/2014 2:22:19 PM	0,04 CPUs + 0,33 NVIDIA GPUs (device 1)	Running		80,0 °C	Boinc
SETI@home	7.00 setiathome_v7	14mr09ag.4171.10706.438086664200.12.192_1	00:18:38 (00:17:24)	94,01	20,540	01:38:09	8/28/2014 9:55:34 AM		Running		72,3 °C	Boinc
SETI@home	7.00 setiathome_v7	15au08ad.1905.72.253403070473.12.245_1	00:15:15 (00:14:07)	91,23	17,305	01:38:29	8/27/2014 12:41:18 AM		Running		72,3 °C	Boinc
SETI@home	7.00 setiathome_v7	13mr09ab.32547.2117.438086664201.12.91_0	00:03:47 (00:03:31)	93,83	9,978	00:40:40	7/26/2014 12:21:55 AM		Running		72,3 °C	Boinc
SETI@home	7.00 setiathome_v7 (cuda50)	20au08ab.13919.20317.438086664204.12.214_1	00:01:56 (00:00:10)	8,98	4,130	00:21:37	8/28/2014 2:35:41 PM	0,04 CPUs + 0,33 NVIDIA GPUs (device 0)	Running		62,7 °C	Boinc
SETI@home	7.00 setiathome_v7 (cuda50)	20au08ab.13919.21544.438086664204.12.4_0	00:01:15 (00:00:08)	9,65	3,624	00:22:16	8/28/2014 2:35:32 PM	0,04 CPUs + 0,33 NVIDIA GPUs (device 1)	Running		80,0 °C	Boinc
SETI@home	7.00 setiathome_v7 (cuda50)	20au08ab.13919.21544.438086664204.12.1_0	00:00:44 (00:00:04)	10,58	1,719	00:22:47	8/28/2014 2:35:32 PM	0,04 CPUs + 0,33 NVIDIA GPUs (device 0)	Running		62,7 °C	Boinc
SETI@home	7.00 setiathome_v7	96 [Tasks], double click to expand	- (-)			05d,17:13:54	7/26/2014 12:32:24 AM		Ready to start			Boinc
SETI@home	7.00 setiathome_v7 (cuda50)	191 [Tasks], double click to expand	- (-)			02d,19:28:44	7/27/2014 3:20:59 PM	0,04 CPUs + 0,33 NVIDIA GPUs	Ready to start			Boinc

Update in 1 seconds, 624 Tasks

efMer, BoincTasks 1.61

Image source: [https://efmer.com/b/img/boinc/bt/bt\\_full\\_max.png](https://efmer.com/b/img/boinc/bt/bt_full_max.png)

# Deadline interface



Jobs

15105 total, 1397 rendering, 13594 queued, 69 completed, 2 pending, 40 suspended, 3 failed, 1 selected

Search...

Job Name	User	Errors	Task Progress	Status	Submit Date/Time	Start Date/Time
Maximum Revenge v004	nicolas.ryan	0	0 % (0/90)	Queued	2014/10/22 12:33:46	
Sarcastic downwards priest failure v0...	vincent.carlson	0	75 % (405/536)	Rendering (3)	2014/10/22 12:33:46	2014/10/22 12:33:57
Maximum Revenge v005	timothy.robertson	0	0 % (0/154)	Queued	2014/10/22 12:33:46	
Lord of all stations v004	jean.farmer	0	93 % (31/33)	Queued	2014/10/22 12:33:47	2014/10/22 12:36:02
Probably debated bucket v002	derek.underwood	0	4 % (4/85)	Rendering (1)	2014/10/22 12:33:47	2014/10/22 14:03:00
Probably just a cube v001	sandy.allison	0	12 % (86/663)	Rendering (1)	2014/10/22 12:33:47	2014/10/22 12:35:38
Mild Pun Blasting v004	patsy.owens	0	0 % (0/116)	Queued	2014/10/22 12:33:47	
Breach philosophical subscription v004	winifred.holt	0	0 % (0/356)	Queued	2014/10/22 12:33:47	
Divesting reinforced stars v002	ronald.reid	0	0 % (0/177)	Queued	2014/10/22 12:33:47	
Maximum Revenge v007	rap.man	0	98 % (187/189)	Queued	2014/10/22 12:33:47	2014/10/22 12:34:29
Fine associated mummy v003	alex.lynych	0	29 % (167/557)	Rendering (1)	2014/10/22 12:33:47	2014/10/22 12:33:56
Twice dry plaster v004	hurdy.gurdy	0	0 % (0/60)	Queued	2014/10/22 12:33:47	
Likely not spheres v002	greg.tucker	0	98 % (90/91)	Queued	2014/10/22 12:33:47	2014/10/22 12:34:33
Sarcastic downwards priest failure v0...	perry.summers	0	0 % (0/356)	Queued	2014/10/22 12:33:47	
Flip welcomed irony v003	ronald.reid	0	0 % (0/48)	Queued	2014/10/22 12:33:47	
Mild Pun Blasting v006	charlene.taylor	0	0 % (0/79)	Queued	2014/10/22 12:33:47	
F6 Barring unset fortune v002	bryan.davis	0	0 % (0/17)	Queued	2014/10/22 12:33:47	
Muscle Mass eXpedition v004	ronald.reid	0	0 % (0/94)	Queued	2014/10/22 12:33:47	
Antiqued digestible donkey v001	shannon.garcia	0	99 % (127/128)	Queued	2014/10/22 12:33:47	2014/10/22 12:33:57
The Hurdy Gurdy Man v006	marcos.douglas	0	0 % (0/148)	Queued	2014/10/22 12:33:48	
Probably just a cube v002	alex.lynych	0	0 % (0/182)	Queued	2014/10/22 12:33:48	
Opposite Textual Five v000	patsy.owens	0	70 % (93/132)	Rendering (1)	2014/10/22 12:33:48	2014/10/22 12:35:29
Fantastic chief crown Deadline v004	nicolas.ryan	0	0 % (0/170)	Queued	2014/10/22 12:33:48	
Ae Twice dry plaster v005	dean.green	0	50 % (57/114)	Rendering (1)	2014/10/22 12:33:48	2014/10/22 12:36:14
Bad Catalogue Rising: Revengeance ...	marcos.douglas	0	0 % (0/61)	Queued	2014/10/22 12:33:48	
Connect Potent Passion v002	crain.nelson	0	0 % (0/40)	Queued	2014/10/22 12:33:48	

Image source: [https://docs.thinkboxsoftware.com/products/deadline/10.1/1\\_User%20Manual/images/monitor\\_job\\_panel.png](https://docs.thinkboxsoftware.com/products/deadline/10.1/1_User%20Manual/images/monitor_job_panel.png)

# OpenCue interface

The screenshot displays the OpenCue interface, which is used for monitoring and managing rendering jobs. The main window is titled "Cuetoopia" and shows a "Monitor Jobs" section. A job named "testing-ts\_04-opencue-user\_title\_sequence" is currently in progress, with 6 of 101 frames rendered, 3 running, and 0 dead, eaten, or wait. The job's progress is shown as a yellow bar at the bottom of the job list.

Below the job list, a detailed view of the job "testing-ts\_04-opencue-user\_title\_sequence" is shown. It includes a table with columns for Name, Services, Range, Cores, Memory, Gpu, MaxRss, Total, Done, Run, Depend, Wait, Eaten, Dead, Avg, and Tags. The job is running on a "render" service with a range of 300-400, using 1.00 cores and 2.0G memory.

The bottom section of the interface is a "LogView" window, which displays a log of frames. The log is limited to 1000 frames and shows the following data:

Order	Frame	Layer	Status	Cores	Host	Retries	CheckP	Runtime	LLU	Memory	Remain	Start Time	Stop Time
0	300	render	SUCCEEDED	1.00	10.154.0.5/1.00	0	0	0:01:46		1.7G		05/29 14:05	05/29 14:07
1	301	render	SUCCEEDED	1.00	10.154.0.3/1.00	0	0	0:01:43		1.6G		05/29 14:05	05/29 14:07
2	302	render	SUCCEEDED	1.00	10.154.0.4/1.00	0	0	0:01:44		1.6G		05/29 14:05	05/29 14:07
3	303	render	SUCCEEDED	1.00	10.154.0.5/1.00	0	0	0:01:44		1.6G		05/29 14:07	05/29 14:09
4	304	render	SUCCEEDED	1.00	10.154.0.3/1.00	0	0	0:01:40		1.6G		05/29 14:07	05/29 14:09
5	305	render	SUCCEEDED	1.00	10.154.0.4/1.00	0	0	0:01:42		1.6G		05/29 14:07	05/29 14:09
6	306	render	RUNNING	1.00	10.154.0.3/1.00	0	0	0:01:09		1.6G		05/29 14:09	
7	307	render	RUNNING	1.00	10.154.0.5/1.00	0	0	0:01:09	00:01:07	1.6G		05/29 14:09	
8	308	render	RUNNING	1.00	10.154.0.4/1.00	0	0	0:01:03	00:00:58	1.6G		05/29 14:09	
9	309	render	WAITING	0.00	/0.00	0	0	0:00:00		OK			
10	310	render	WAITING	0.00	/0.00	0	0	0:00:00		OK			
11	311	render	WAITING	0.00	/0.00	0	0	0:00:00		OK			
12	312	render	WAITING	0.00	/0.00	0	0	0:00:00		OK			
13	313	render	WAITING	0.00	/0.00	0	0	0:00:00		OK			

The log view also shows a detailed log of frames, including memory usage, peak memory, and time taken for each frame. The log is currently showing frames 300 through 300, with a total of 1 frame displayed. The log is limited to 1000 frames.

Image source: <https://www.opencue.io/docs/user-guides/monitoring-your-jobs/>

# Prism Pandora interface

The screenshot displays the Prism Pandora interface, which is used for managing rendering jobs. It is divided into several sections:

- Jobs Table:** A table listing rendering jobs with columns for Name, Status, Progress, Prio, Frames, Submit Date, Project, User, and Progr. The jobs are numbered 1 through 25. Some jobs are in progress (e.g., job 2 at 47% progress), while others are finished or ready.
- Task List Table:** A table on the right side showing task details with columns for Num, Frames, Status, Slave, Render time, Start, and End. It lists tasks 00 through 16, including their frame ranges and completion times.
- Slaves Table:** A table at the bottom showing the status of rendering slaves. Columns include Name, Status, Job, last Contact, Warnings, RAM, and Cores. Slaves are numbered 1 through 16, with various statuses like 'rendering', 'disabled', and 'not responding'.
- Log Window:** A window on the right side showing a log of rendering activities, including messages like '[Redshift] Done!', '[Redshift]RS render object initialized successfully', and '[Redshift]Rendering frame...'. It also shows a log size of 0.64mb and a filter level of 0.

Image source: <https://prism-pipeline.com/wp-content/uploads/2018/03/RH004c.jpg>

# Grafana interface to monitor Kafka message queue

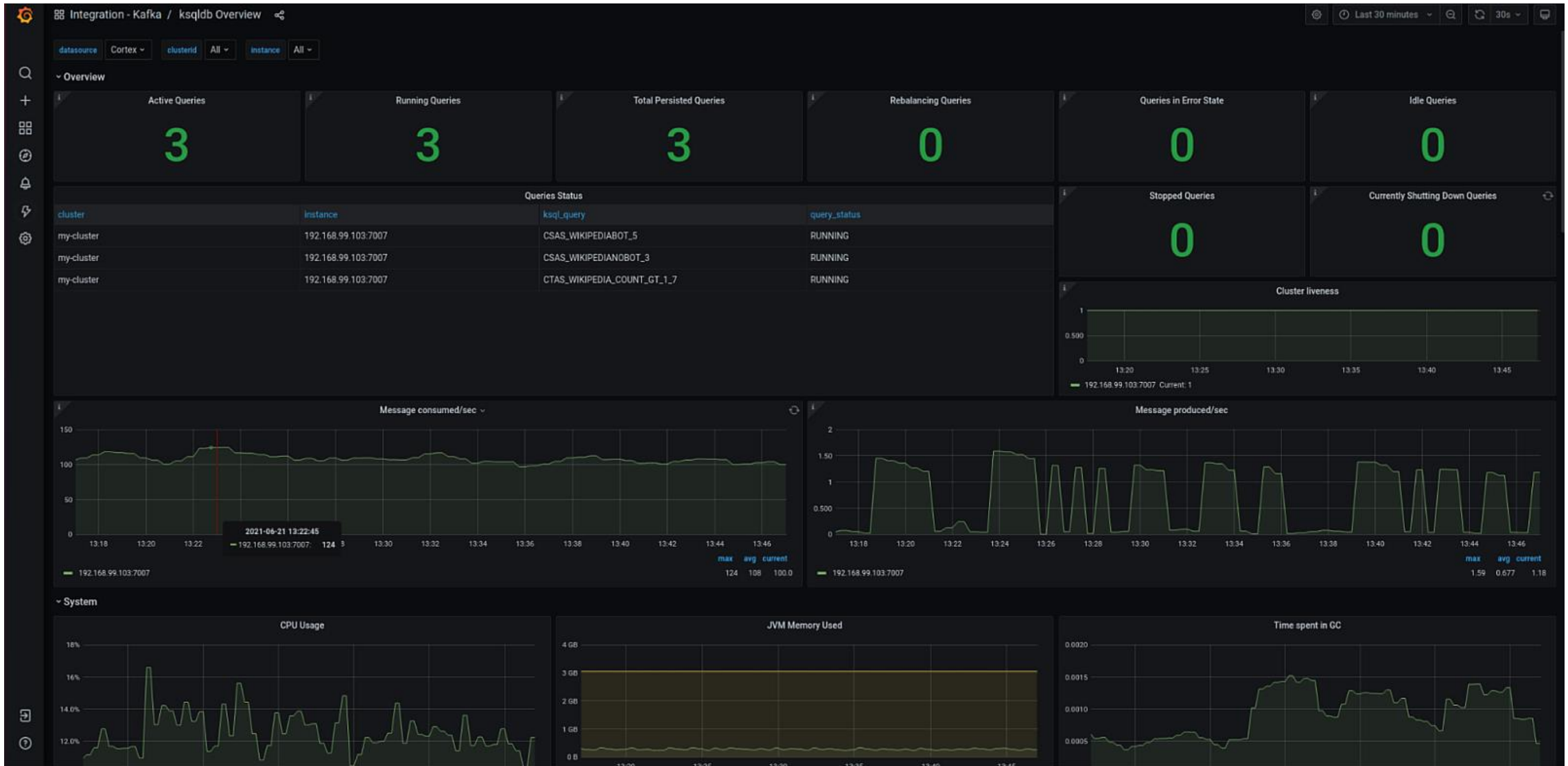


Image source: [https://grafana.com/static/assets/img/blog/kafka\\_integration\\_ksqldb.png](https://grafana.com/static/assets/img/blog/kafka_integration_ksqldb.png)

# For further reading

## **BOINC**

<https://boinc.berkeley.edu/>

## **AWS Thinkbox Deadline**

<https://aws.amazon.com/thinkbox-deadline/>

## **OpenCue**

<https://www.opencue.io/>

## **Prism**

<https://prism-pipeline.com/>

## **Grafana**

<https://grafana.com/solutions/kafka/monitor/>