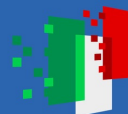




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Advancements in Monitoring Infrastructure at INFN-T0 Computing Centre

Workshop sul calcolo nell'INFN

La Biodola - Isola d'Elba

27/05/2025

Nicola Mosco
INFN TO



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Outline

- Computing resources in Turin
- Monitoring infrastructure
- Dashboard design
- Machines database
- Future developments



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Computing resources & project synergy

CTLab (*Computing Technology Lab*):

- 4×Dell PowerEdge R7525:
 - 2×(AMD EPYC 7313 3.0 GHz 16 cores)
 - 1TB RDIMM, 3200 MT/s
 - 2×(AMD MI100, 32GB)
 - 1×(NVIDIA A16, 4×16GB)
 - 2×(NVIDIA A5000, 24GB)
- 3×Lenovo SR675v3:
 - 2×(AMD EPYC 9124 3.0 GHz 16 cores)
 - 1TB RAM (expandable)
 - 2×(NVIDIA L40S, 48GB)
- 1×NVIDIA GraceHopper superchip, evaluation system by E4:
 - CPU+GPU coherent memory model
 - 900 GB/s interface NVLink-C2C
- Connectivity: InfiniBand + NVIDIA ConnectX-7 400 Gb/s

TeRABIT:

- 6×Lenovo SR665v3:
 - 2×(AMD EPYC 9654 96-Core Processor)
 - 1,5 TB RAM
- 6×Lenovo SR675v3:
 - 2×(AMD EPYC 9654 96-Core Processor)
 - 1,5 TB RAM
 - 4×(NVIDIA H100 80GB)
 - NVIDIA ConnectX-7 400 Gb/s
- 1×InfiniBand switch 400 Gb/s
- Connectivity: NVIDIA ConnectX-7 400 Gb/s

Synergic and consistent management
computing resources



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Monitoring infrastructure design

Machines and resources catalog:

- PostgreSQL (*the database*)

Metrics collection:

- Redfish
- SNMP

Time series database:

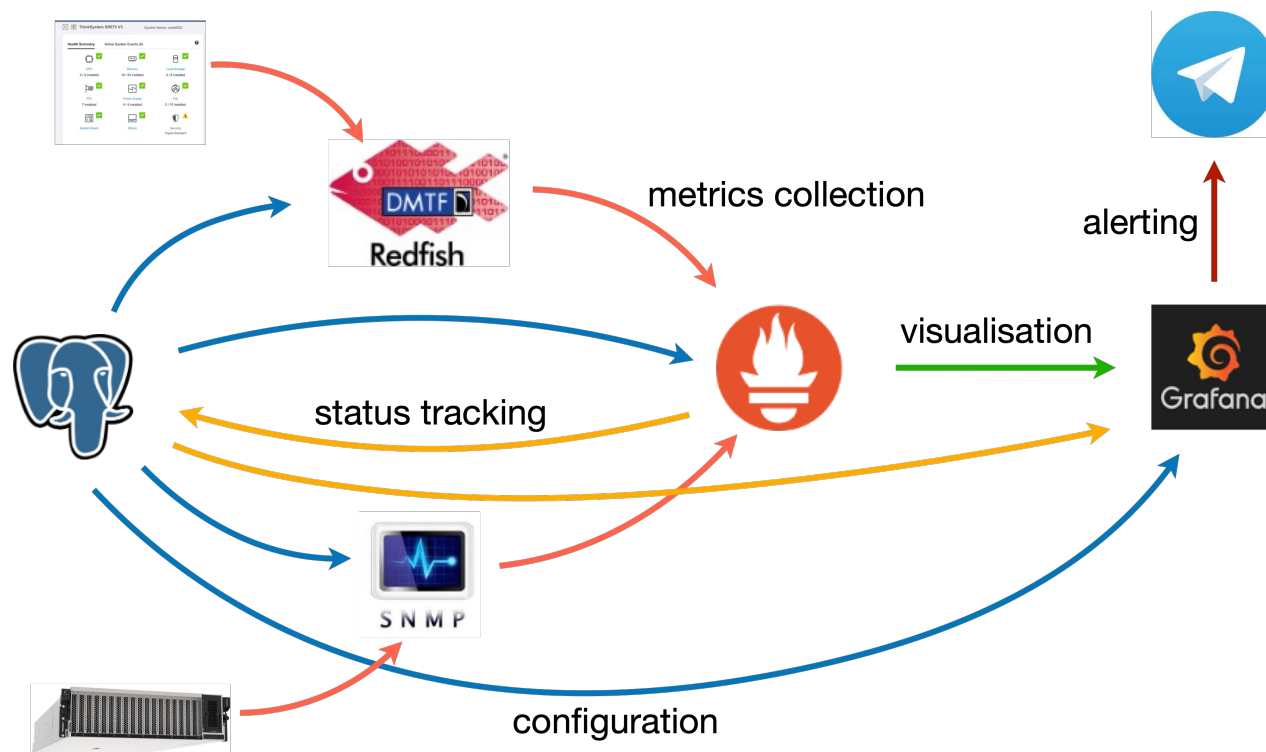
- Prometheus

Data visualization:

- Grafana

Alerting:

- Currently, Grafana + Telegram





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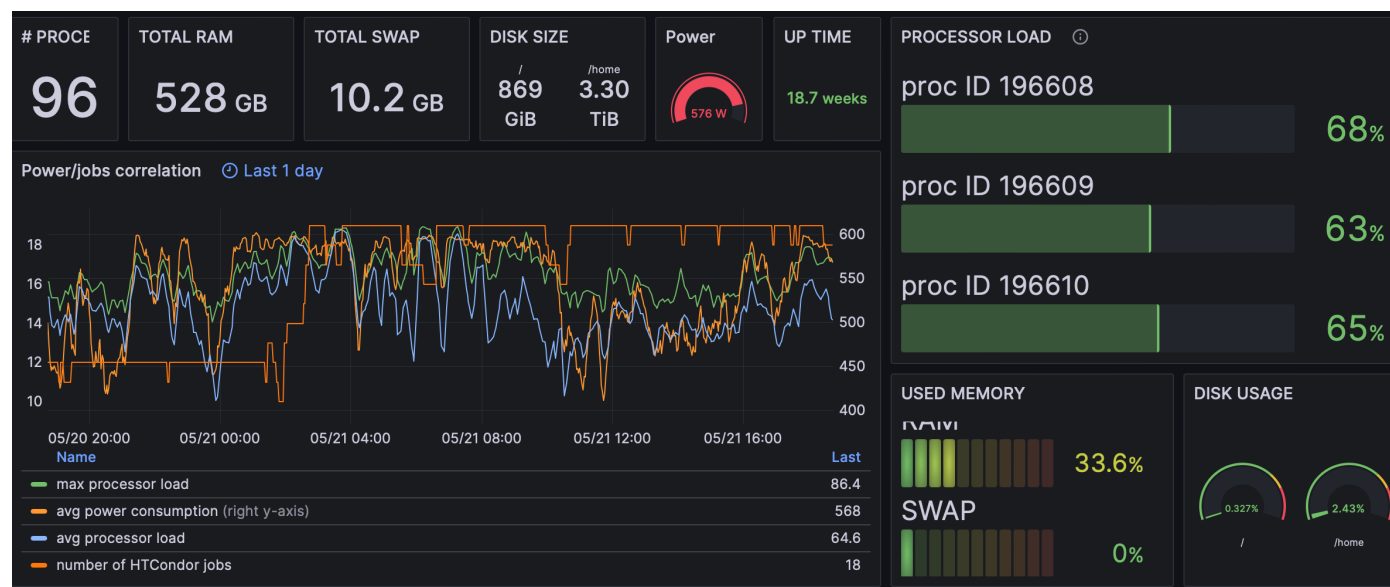
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What we had last year

- Basic metrics of machines: CPU, RAM, disk usage and power metrics.
- For HTCondor nodes, correlation between power consumption and number of jobs.





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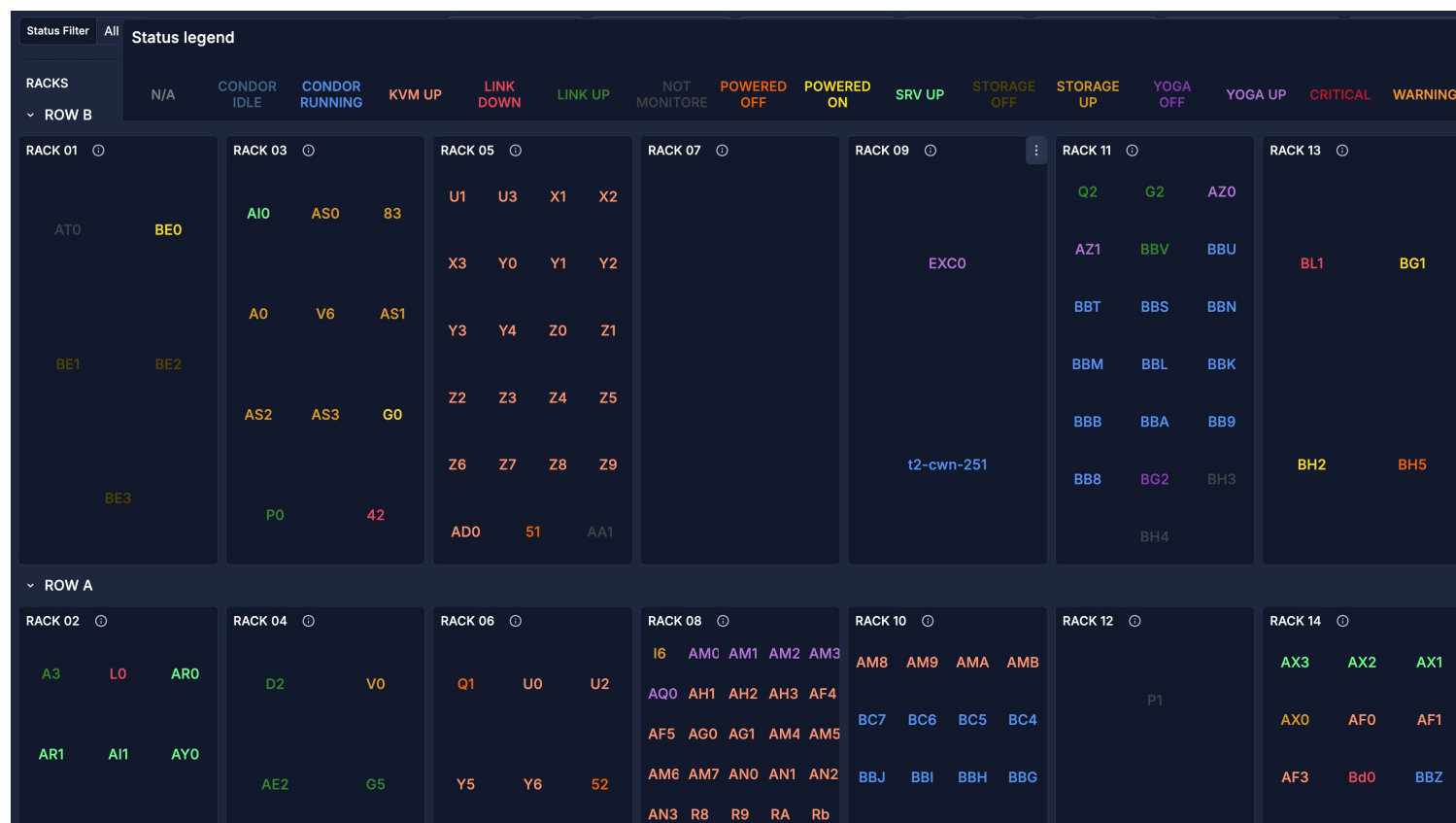
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What we have now

- Visualise machines in their location.
- Node identification.
- Color codes for synthetic status display: role & status.
- States, categories, and codes are configured in the database.
- Monitoring status: ping, power state, HTCondor



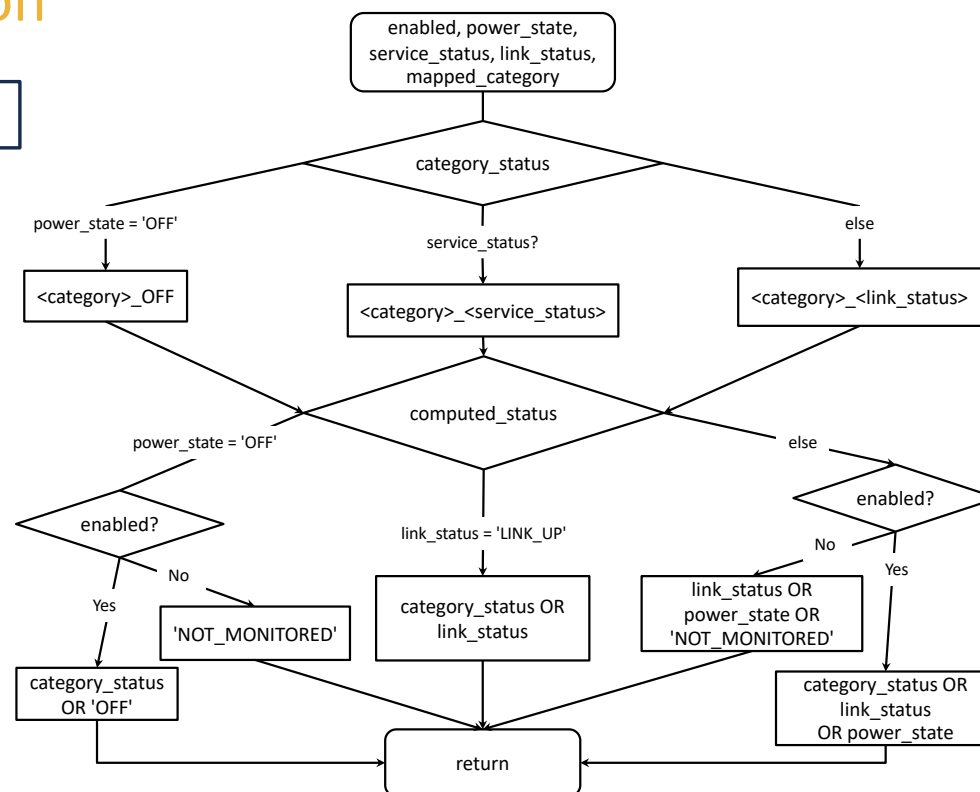
Dashboard design: Status determination

```
category_status = mapped_category + status suffix
```



```
computed_status
```

Status Filter		AI		Status legend																																	
RACKS - ROW B		N/A		CONDOR IDLE		CONDOR RUNNING		KVM UP		LINK DOWN		LINK UP		NOT MONITORED		POWERED OFF		POWERED ON		SERV UP		STORAGE OFF		STORAGE UP		YOGA OFF		YOGA UP		CRITICAL		WARNING					
RACK 01		⊖		RACK 03		⊖		RACK 05		⊖		RACK 07		⊖		RACK 09		⊖		1		RACK 11		⊖		RACK 13		⊖									
AZ0		BEO		A00		A50		83		U1		U3		X1		X2						G2		G2		AZ0											
				A0		V6		A51		Y3		Y4		Z0		Z1						B0T		B5V		B5U		B11		B01							
B01		B02								Y3		Y4		Z0		Z1						B0M		B0L		B0N											
				A52		A53		00		Z2		Z3		Z4		Z5						B0B		B0A		B0B											
										Z6		Z7		Z8		Z9																					
B03				P0				42														12-cwn-251															
				A00		S1		A01																		B14											
- ROW A																																					
RACK 02		⊖		RACK 04		⊖		RACK 06		⊖		RACK 08		⊖		RACK 10		⊖				RACK 12		⊖		RACK 14		⊖									
A3		L0		A00		G2		V0		Q1		U0		U2				A05		A01		A02		A03		A33		A32		A31							
																		B07		B0C		B0C5		B0C4				P1		A30		A30		A31			
A01		A11		A30		A02		G5		Y5		Y6		S2				A05		A01		A02		A03		A04		A05		B0J		B0I		B0H		B0G	



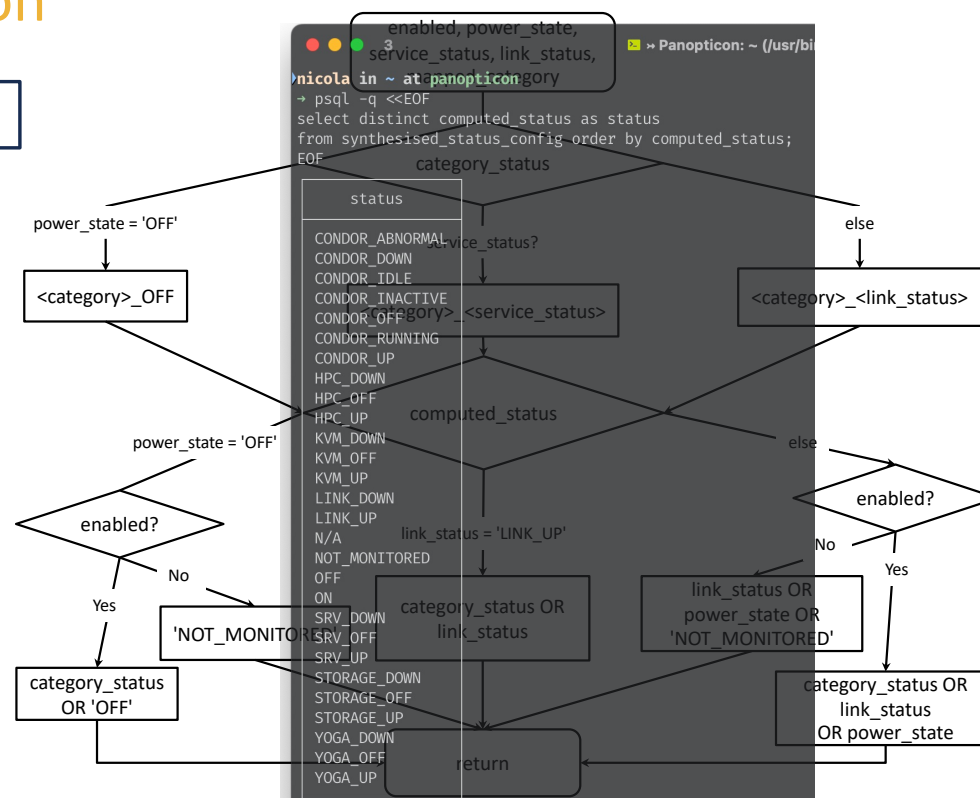
Dashboard design: Status determination

```
category_status = mapped_category + status suffix
```



```
computed_status
```

Status Filter		All		Status legend																																			
RACKS		ROW B		N/A		CONDOR IDLE		CONDOR RUNNING		KVM UP		LINK DOWN		LINK UP		BUT MONITORED		POWERED OFF		POWERED ON		SERV UP		STORAGE OFF		STORAGE UP		YOGA OFF		YOGA UP		CRITICAL		WARNING					
RACK 01						RACK 03				RACK 05				RACK 07				RACK 09				1				RACK 13													
ATO		BEO				AO0		AS0		B3		U1		U3		X1		X2						EXCD		G2		G2		AZ0									
												X3		Y0		Y1		Y2								AZ1		BBV		BBU		BL1		BG1					
BB1		BB2				AO		V6		AS1		Y3		Y4		Z0		Z1								BBT		BB5		BBN									
						AS2		AS3		Q0		Z2		Z3		Z4		Z5								BBM		BBL		BBK									
BB3												Z6		Z7		Z8		Z9						12-cmn-251		BBB		BBA		BB9									
BB5						FO				42																BBB		BQ2		BB3		BH2		BHS					
												ADD		S1		A61												BH4											
ROW A																																							
RACK 02						RACK 04				RACK 06				RACK 08				RACK 10								RACK 12								RACK 14					
A2		LO		AR0		D2		V0		Q1		U0		U2		16		AMC		AM1		AM2		AM3		AM6		AM9		AMA		AMB		A23		A32	A31		
																AQ0		AH1		AH2		AH3		AF4		BC7		BC6		BC5		BC4		P1		AX0		AF0	AF1
AR1		AR1		AY0		AE2		G5		Y5		Y6		S2		AM4		AM3		AM2		AM1		AN2		AN2		BBJ		BBI		BBH		BBG		AF3		BA0	BB2





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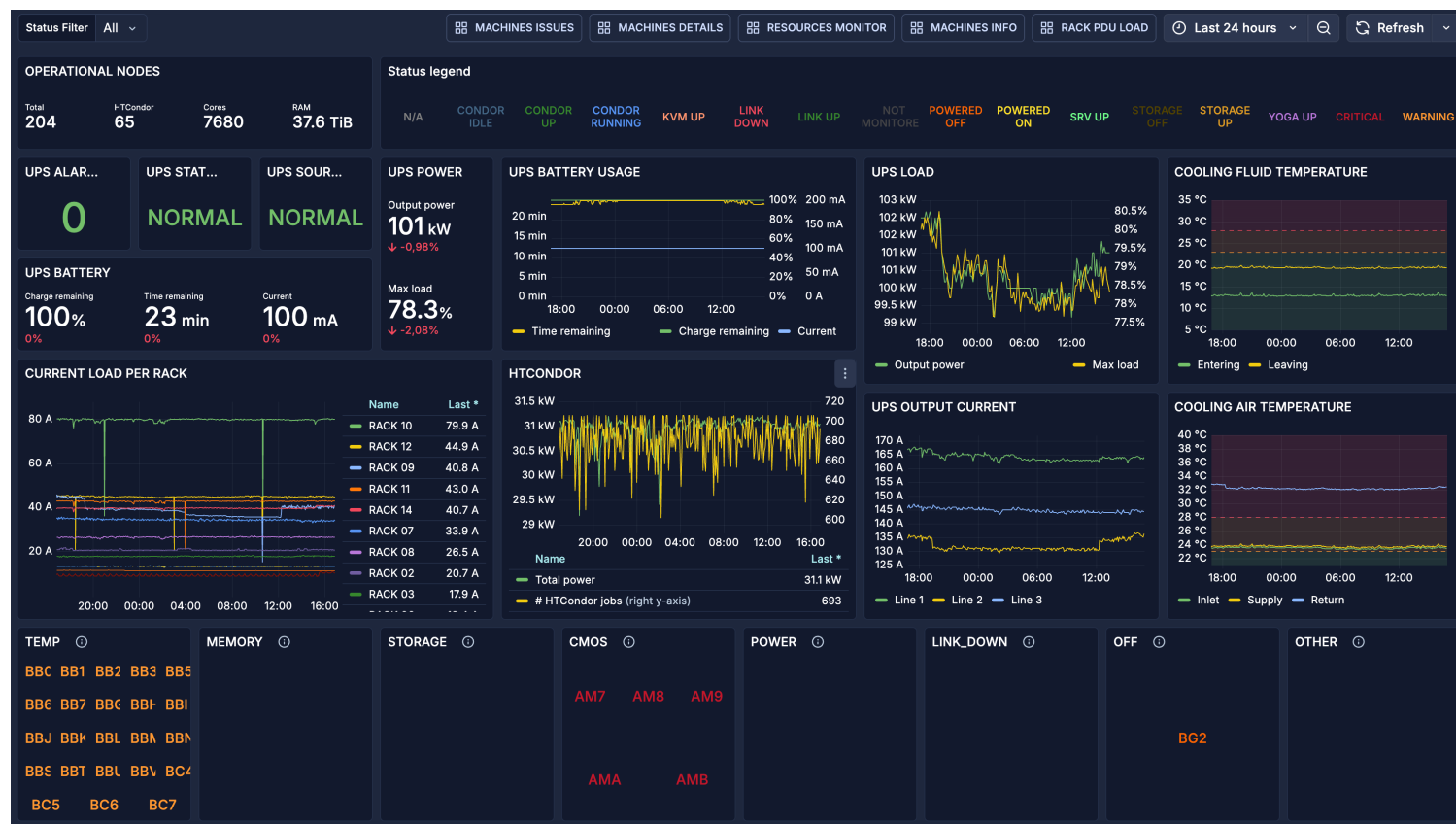


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What we have now

- General status overview
- Resource usage
- Health issues detection





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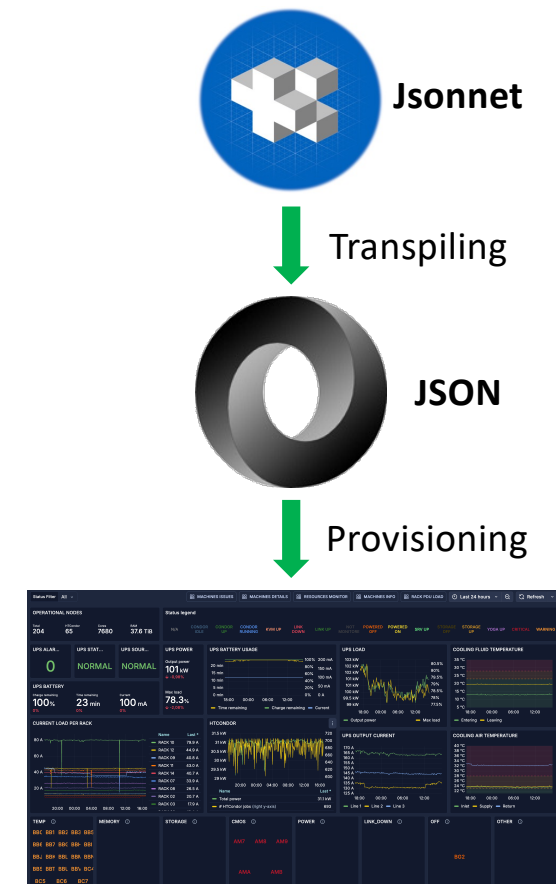
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Dashboard design with Grafonnet

- Grafonnet: Jsonnet library for generating Grafana dashboards.
- Jsonnet:
 - Configuration language that *transpiles* to JSON (source to source translation, same abstraction level).
 - Functional style (no side-effects).
- Fit into pipeline for provisioning of dashboards and easier (wrt. JSON) versioning.
- All well and good, but... **double the effort!**
 - Grafonnet lags behind GUI features.
 - Need to rewrite GUI-generated dashboard to Jsonnet code.





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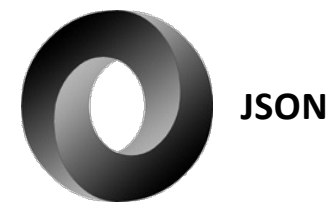
Dashboard design with Grafonnet

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- Jsonnet:
 - Configuration language that transpiles to JSON.
 - Functional style (no side-effects).
- Fit into pipeline for provisioning of dashboards.
- All well and good, but... **double the effort!**
 - Grafonnet lags behind of GUI features.
 - Rewriting GUI with Jsonnet code.

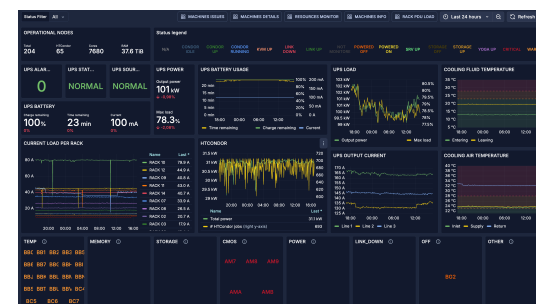
Failed attempt!



Transpiling



Provisioning





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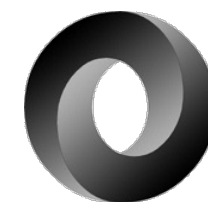


Dashboard design ~~with Grafonnet~~ with GUI

- Develop dashboards with GUI.
- Take JSON source.
- Provisioning pipeline.

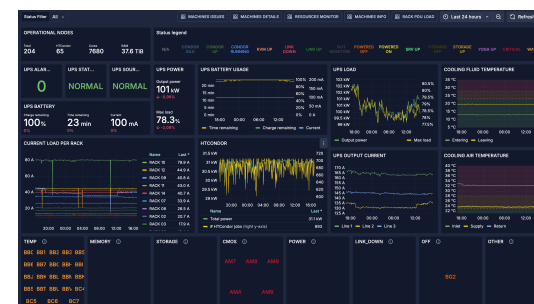


No-code development



JSON

Provisioning





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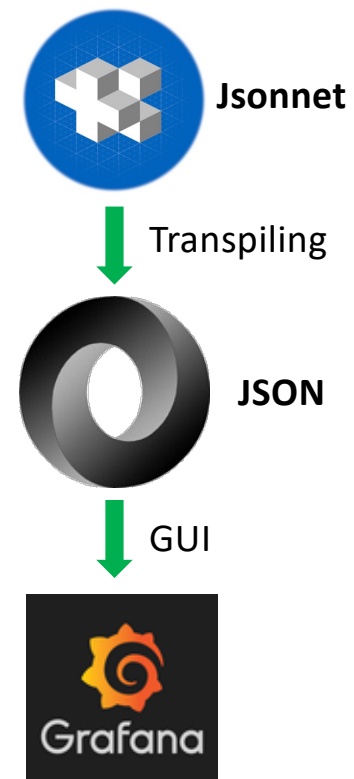
Dashboard design *with Grafonnet*: Initial development

- Develop complex logic with Jsonnet.
- Take JSON source to define new dashboard in Grafana.
- Continue development with GUI.

Jsonnet machinery useful for initial development!



Static generation of complex layouts





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Dashboard design *with Grafonnet*: Initial development

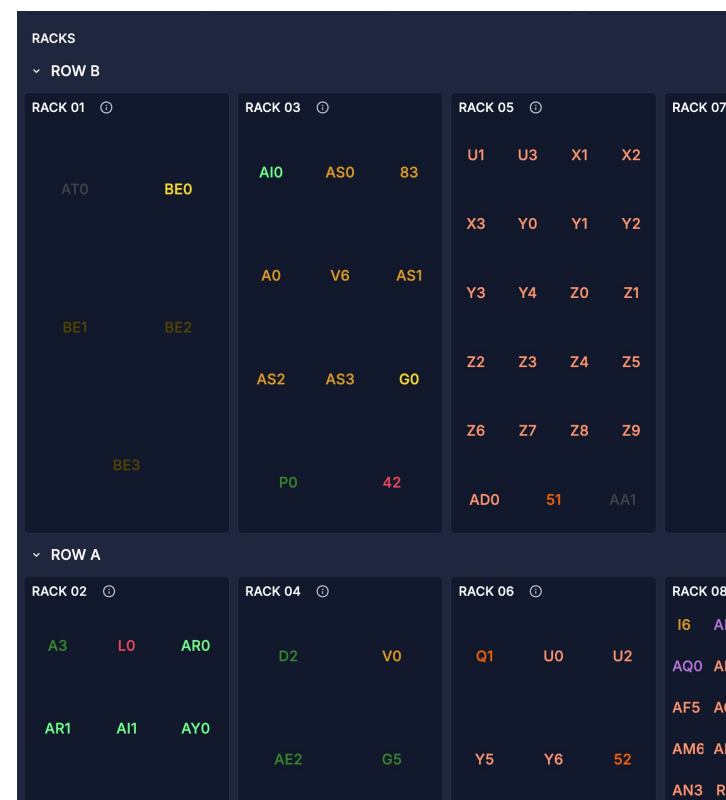
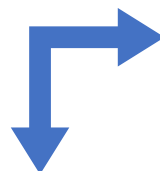
- Hard to deal with simultaneously-varying, correlated variables in Grafana GUI.
- There is no support (yet) for variables defined at row level.



Use Jsonnet to create multiple variables depending on configuration, defined in the database.

Racks in each line

Rack lines

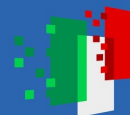




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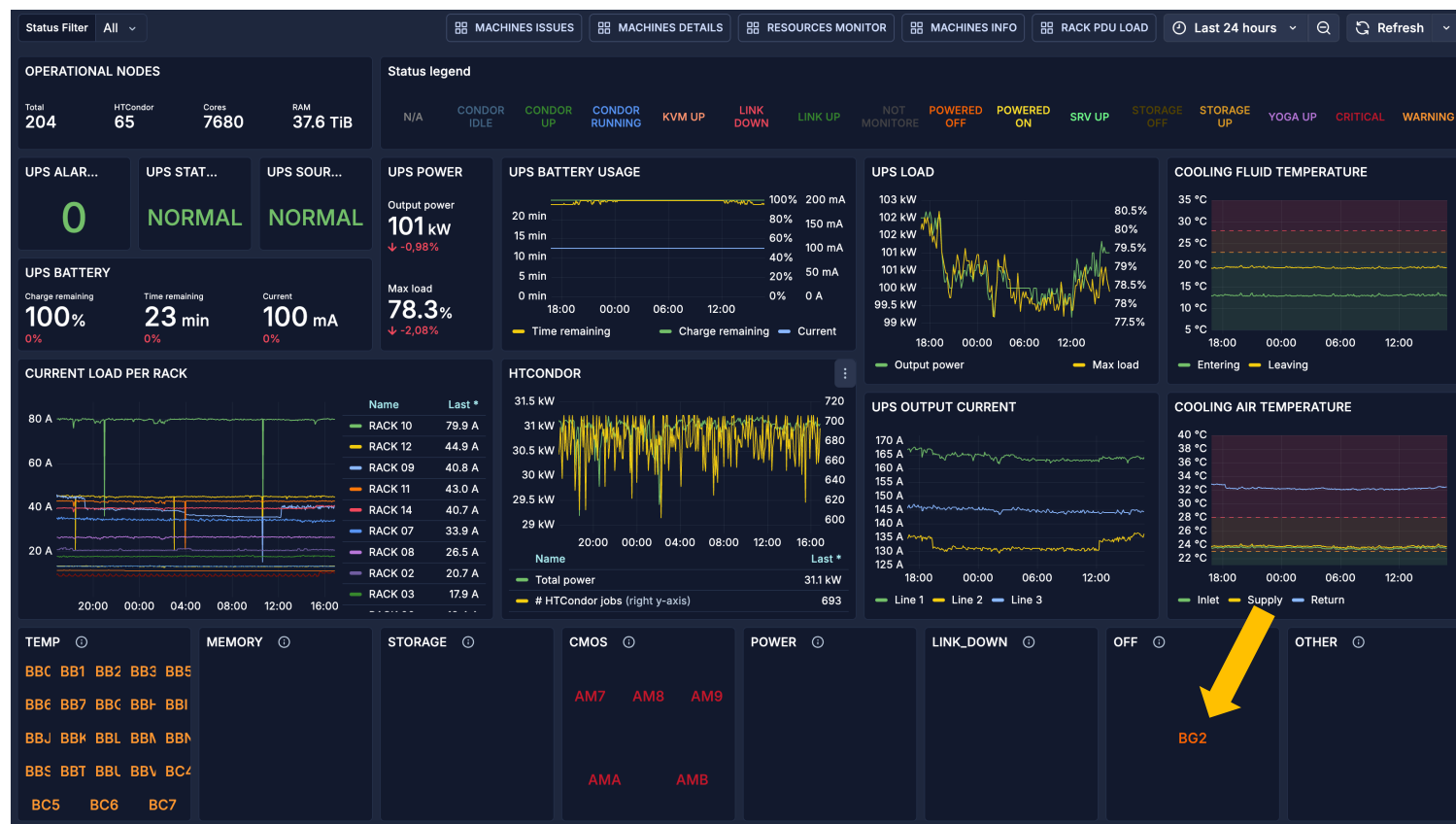


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What we have now

Machine reported as
powered-off:
click to open the
detailed view...





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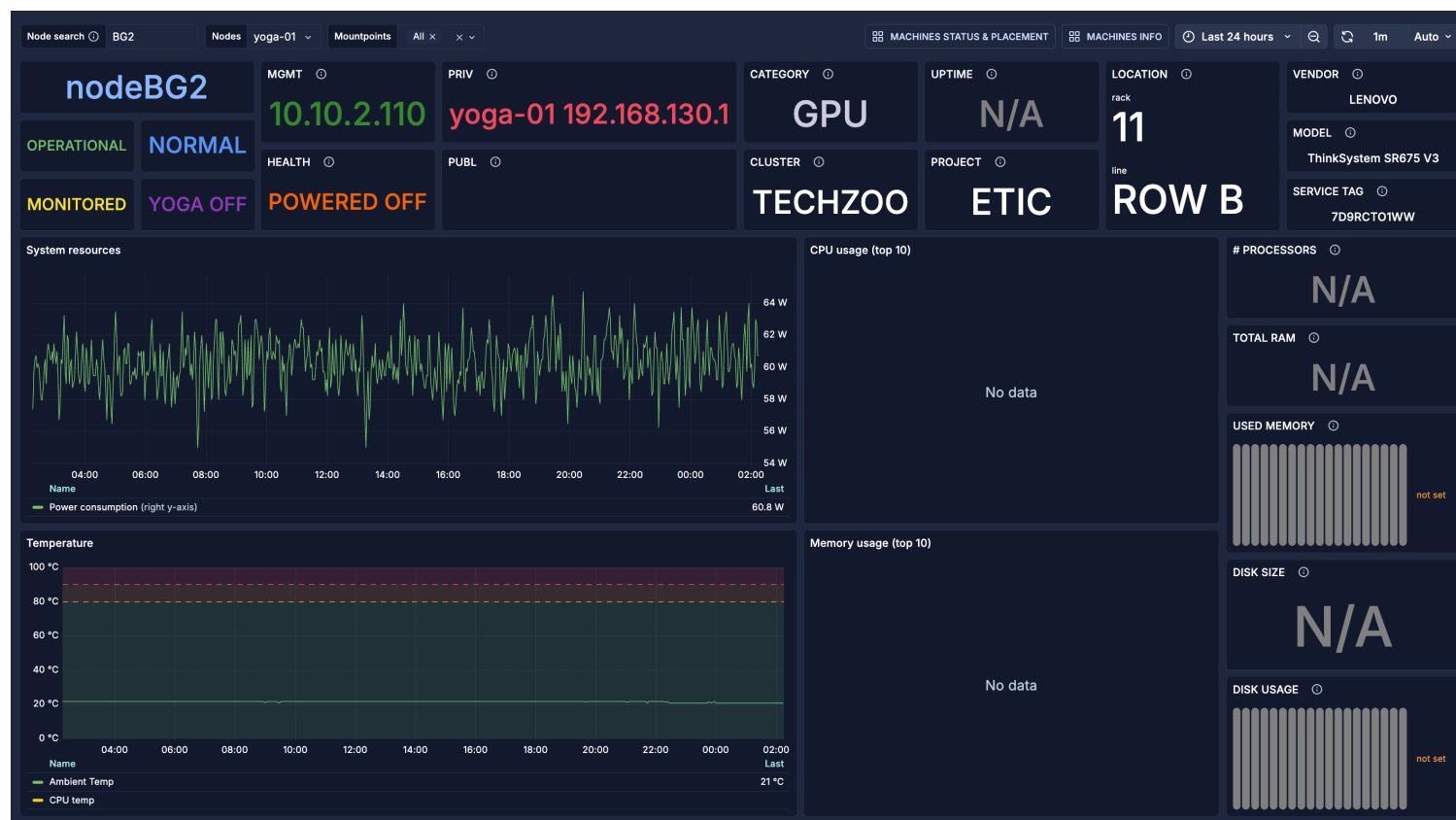


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What we have now

Detailed machine view

- Resource usage.
- Power and temperature metrics.
- Service state.
- Link to BMC page.





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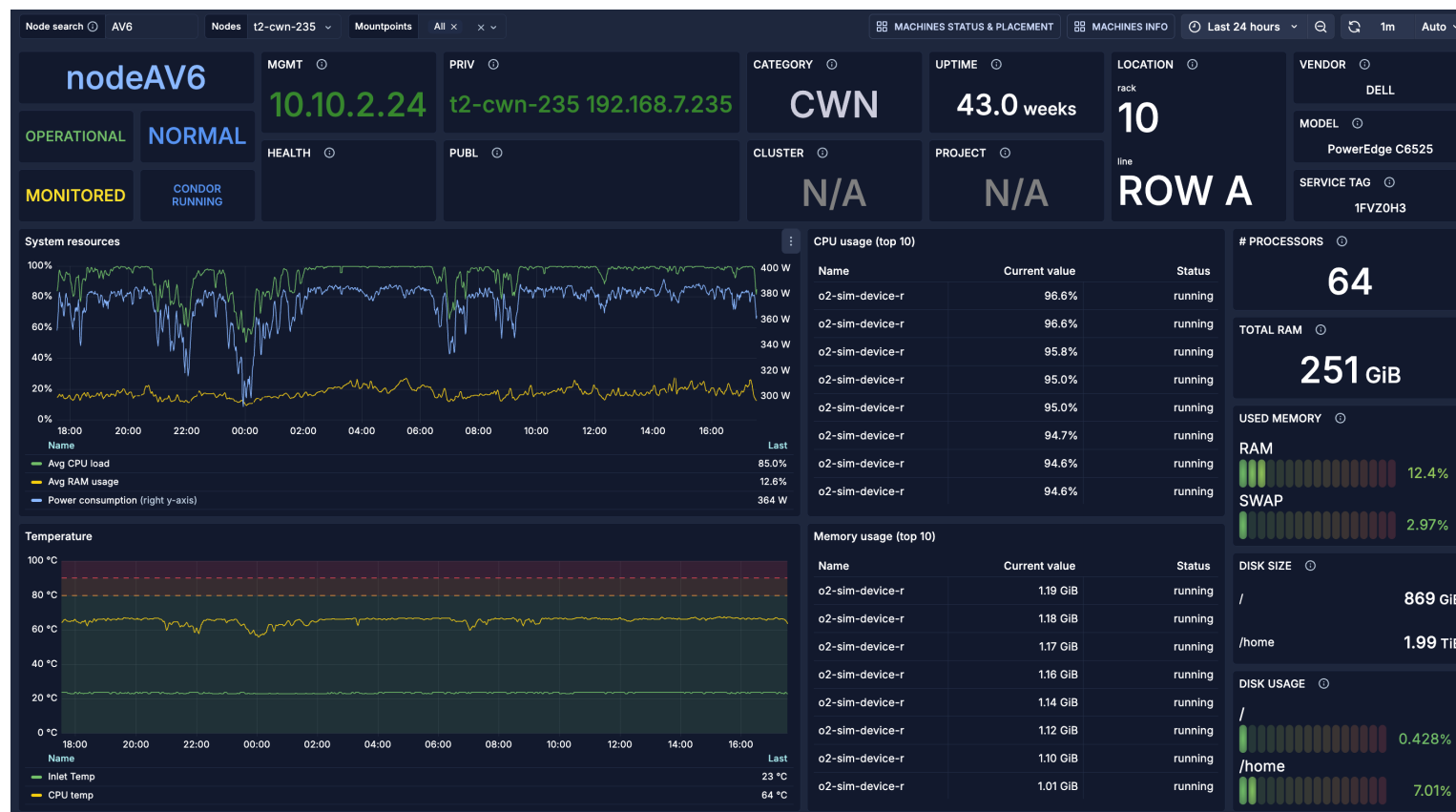


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What we have now

Detailed machine view

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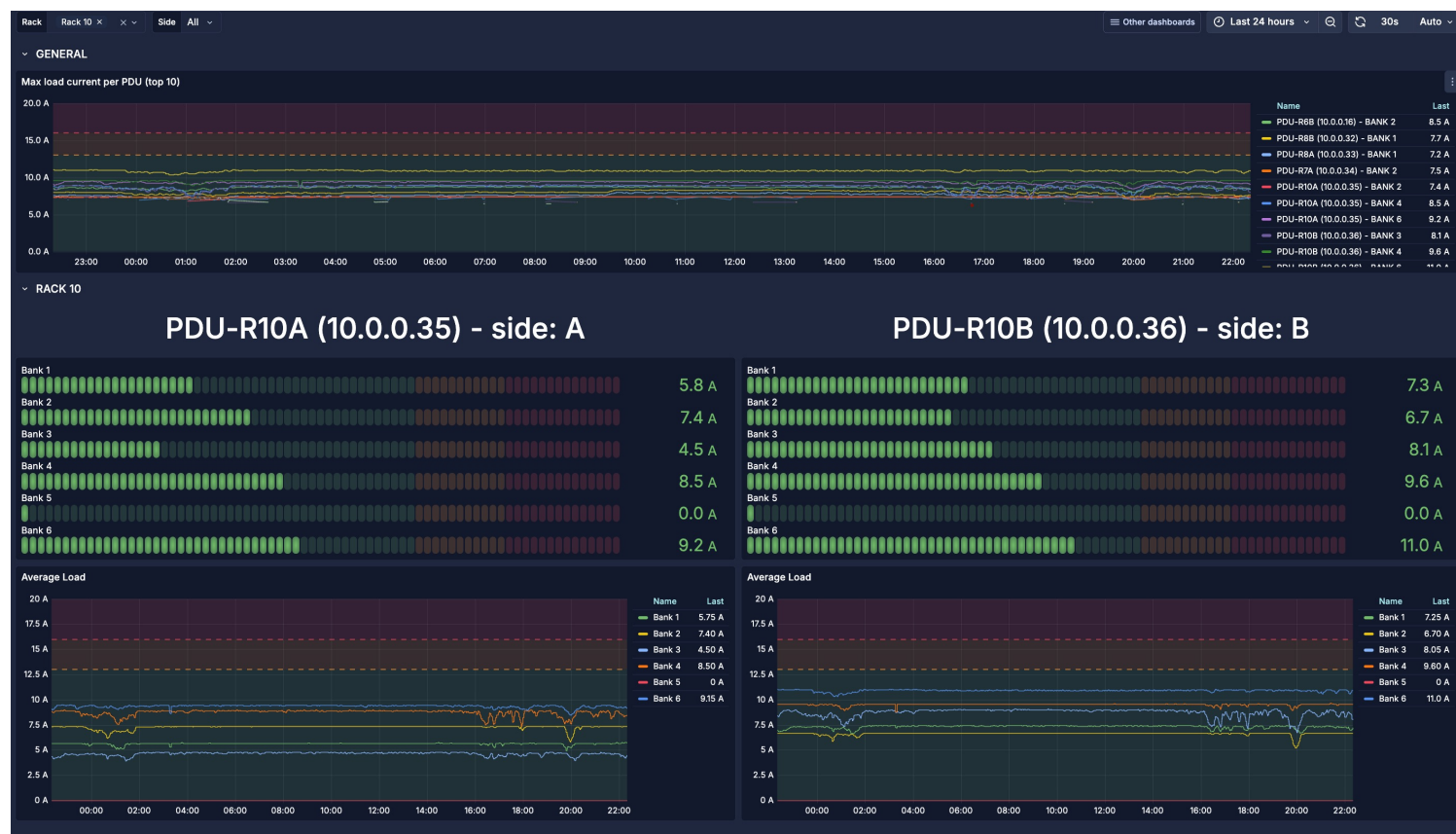


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What we have now

Power supply load per-rack

- Power supply monitoring.
- Load distribution per rack.
- Alerting based on parameters configured in the database.





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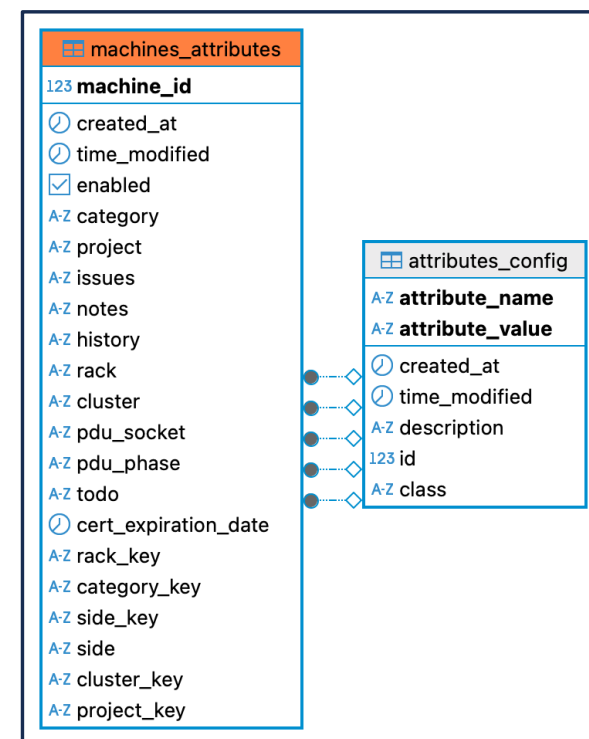
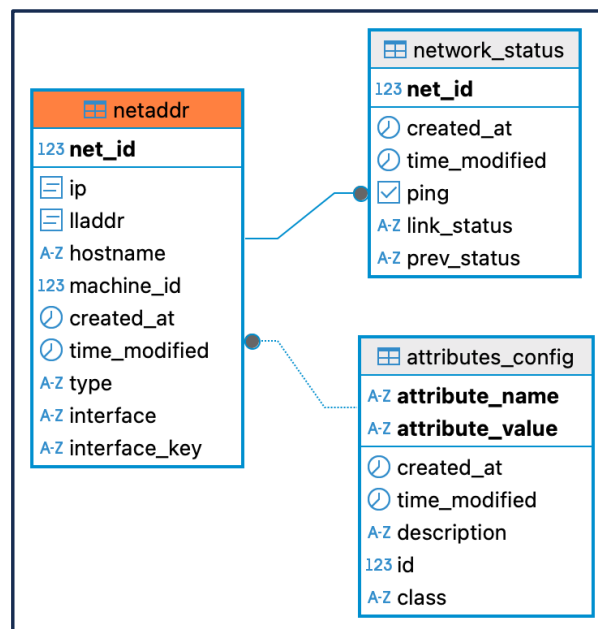
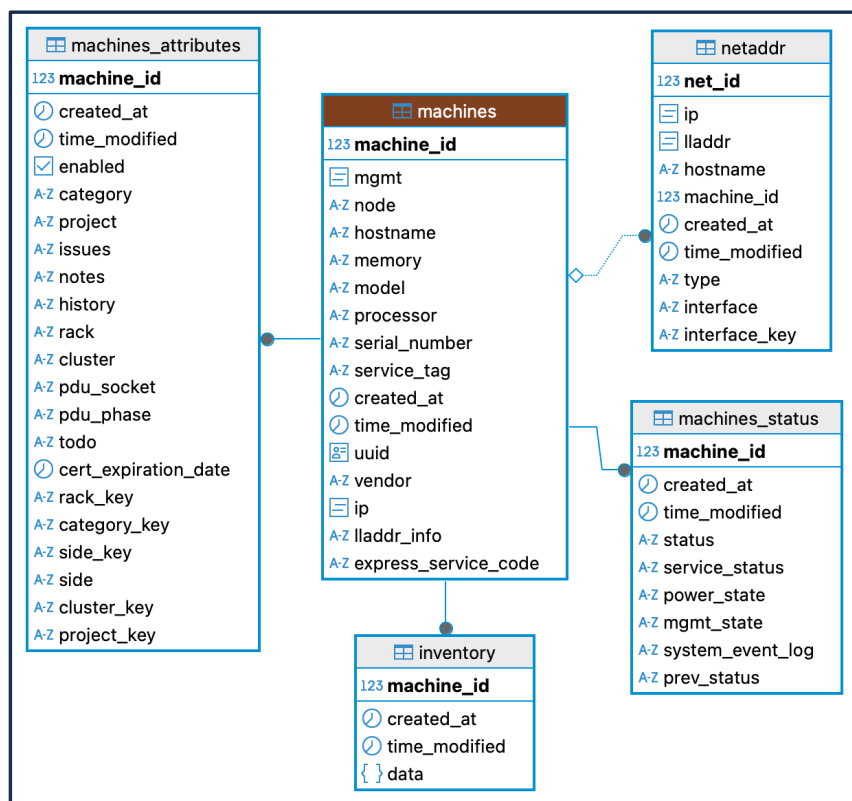
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Machines database





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Machines database: CLI

- CLI interface to perform low level operation on each of the 3 main tables.
- CLI commands have comprehensive man pages.

```
DB(1)                                CDCTO Database Documentation                                DB(1)

NAME
  db - Command-line interface for infrastructure database management without SQL knowledge

SYNOPSIS
  db [OPTIONS] SUBCOMMAND [ARGS]

DESCRIPTION
  The db utility provides a command-line interface for database management without SQL knowledge. It simplifies core operations for your infrastructure database through intuitive commands that handle machine registration, network configuration updates, and attribute management.

  Purpose and design philosophy
  This tool follows a minimalist design philosophy, focusing on common administrative tasks while maintaining a simple interface. When working with this utility, you will primarily interact with:

  • Essential machine information: Register nodes with their node names.
  • Network configuration: Manage IP addresses, interfaces, and hostnames.
  • Operational attributes: Track category, notes, and other organizational metadata.

  The tool deliberately separates concerns: hardware-specific properties (vendor, serial_number, service_tag, memory, processor) are meant to be automatically populated through the companion bmc_inventory tool using standardized BMC interfaces. This separation ensures data integrity and reduces manual input errors.

  Key features
  • Simple command structure: Intuitive syntax for common database operations;

Manual page db(1) line 1 (press h for help or q to quit)
main
```




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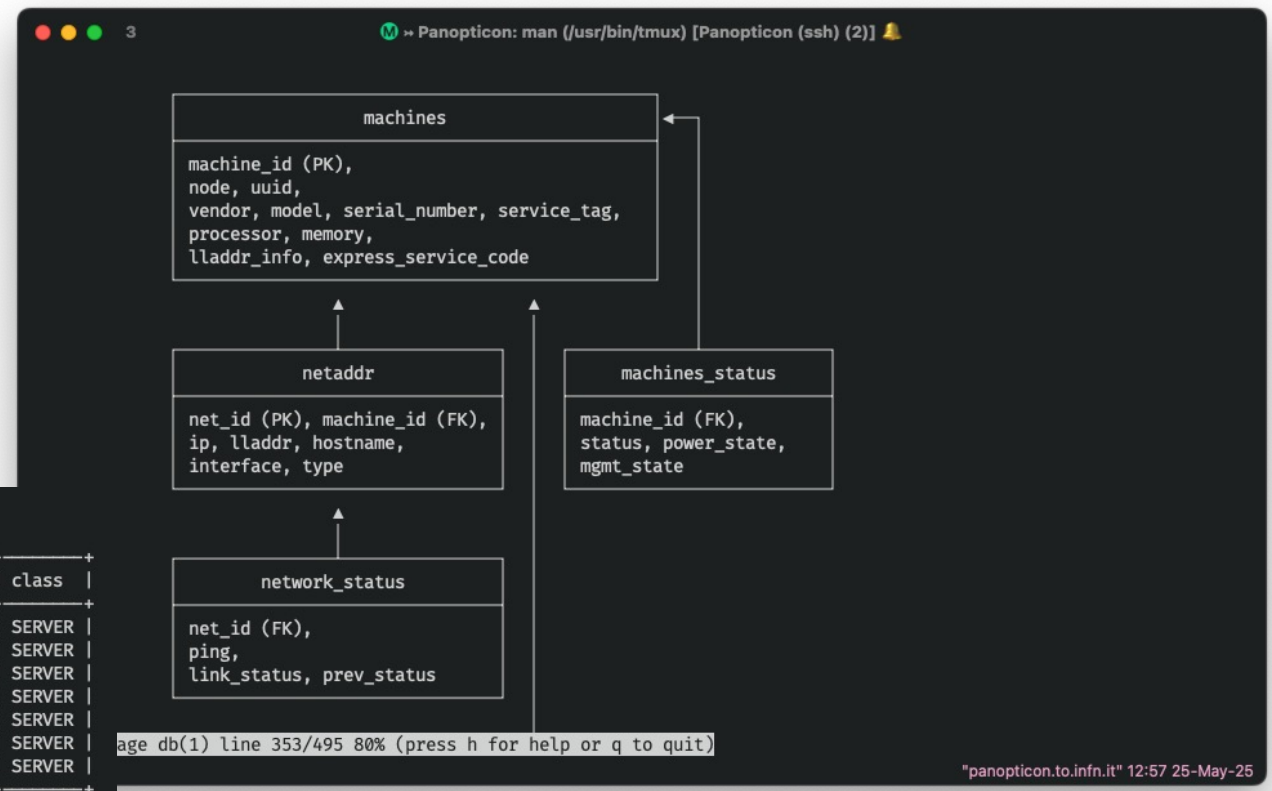


Machines database: Schema

- CLI interface to perform low level operation on each of the 3 main tables.
- CLI commands have comprehensive man pages.
- Schema and attribute values.

```
nicola in ~ at panopticon took 3.2s  
→ db show attributes  
+-----+  
| attribute_name |  
+-----+  
| category  
| cluster  
| health_issue  
| interface  
| line  
| mapped_category  
| project  
| rack  
| side  
+-----+
```

```
nicola in ~ at panopticon  
→ db show attributes project  
+-----+-----+-----+  
| project | description | class |  
+-----+-----+-----+  
| Alice | Machines for Alice project | SERVER |  
| BELLE | Machines for BELLE project | SERVER |  
| ETIC | Machines for PNRR ETIC project | SERVER |  
| ICSC | Machines for PNRR ICSC project | SERVER |  
| N/A | Undefined project | SERVER |  
| SkyNet | Machines for PRIN SkyNet project | SERVER |  
| TeRABIT | Machines for PNRR TeRABIT project | SERVER |  
+-----+-----+-----+
```





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Inventory retrieval

- CLI interface to get inventory from BMC.
- PostgreSQL views for easy access to relevant information (processors, memory, disks, etc...).
- Thanks to check_redfish.py script: plugin for Nagios, NetBox, Icinga2.

https://github.com/bb-Ricardo/check_redfish

```
3 M » Panopticon: man (/usr/bin/tmux) [Panopticon (ssh) (2)] 🔔
BMC_INVENTORY(1) CDCTO Database Documentation BMC_INVENTORY(1)

NAME
    bmc_inventory - updates the configuration database with BMC hardware information

SYNOPSIS
    bmc_inventory [OPTIONS] [SUBCOMMAND] [PSQL_OPTIONS]

DESCRIPTION
    The bmc_inventory tool collects hardware information from computing nodes through their Baseboard Management Controller (BMC) interfaces and stores this data in the database. It leverages the Redfish protocol to efficiently communicate with BMC controllers and retrieve detailed hardware component data.

Key features
    The tool supports multiple operations including:

3 » Panopticon: ~ (/usr/bin/tmux) [Panopticon (ssh) (2)] 🔔
nicola in ~ at panopticon
→ bmc_inventory show -m nodeBG2 | jq .power_supply | mlr --j2p --barred cut -f id,bay,health_status,name,type,model,serial,manufacturer,capacity_in_watt
+-----+-----+-----+-----+-----+-----+-----+-----+
| id | bay | name | type | model | serial | health_status | capacity_in_watt |
+-----+-----+-----+-----+-----+-----+-----+
| 1.0 | Slot 1 | PSU1 | AC | LENOVO-SP57A86677 | A3DB3B310WA | OK | 2600 |
| 1.1 | Slot 2 | PSU2 | AC | LENOVO-SP57A86677 | A3DB3B310VS | OK | 2600 |
| 1.2 | Slot 3 | PSU3 | AC | LENOVO-SP57A86677 | A3DB3B310VR | OK | 2600 |
| 1.3 | Slot 4 | PSU4 | AC | LENOVO-SP57A86677 | A3DB3B310WC | OK | 2600 |
+-----+-----+-----+-----+-----+-----+-----+
nicola in ~ at panopticon
→
```



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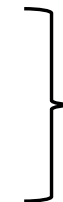
Future developments

- Analysis of aggregated data over a long period of time.
- Long term storage of relevant metrics.



Aggregate metrics and statistics:

- Thanos
- Cortex
- Mimir
- VictoriaMetrics
- TimescaleDB + PostgreSQL



Native Prometheus
support



Long term goals for the monitoring:

- Additional infrastructural components: Cooling systems and incident response.
- Higher abstraction layers: Integrate monitoring of cloud and orchestration layers (e.g. OpenNebula).
- Monitoring of the application layer (e.g. JupyterHub/JupyterLab).



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Conclusions

Thank you!

- Monitoring infrastructure: PostgreSQL for machines catalog, Redfish and SNMP for metrics collection, Prometheus for metrics ingestion, Grafana for visualization.
- CLI interface for simplified database management.
- Provisioning pipeline of datasources and dashboards in Grafana.
- Future development: Storage devices are not yet in the database, long term storage of relevant metrics; enhance monitoring coverage to infrastructural components (like cooling appliances), cloud and orchestration layer (OpenNebula), and applications layer.



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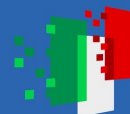
BACKUP SLIDES



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Computing infrastructure

HTC Cluster (WLCG Tier 2)

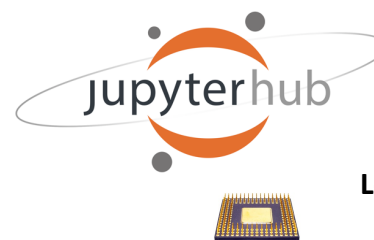


ALICE



BELLE

Yoga cluster



Local cluster for ML

CTlab4ET



GraceHopper

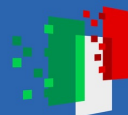




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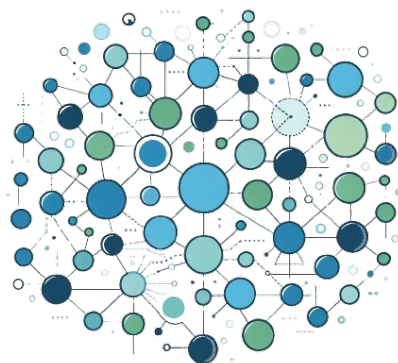
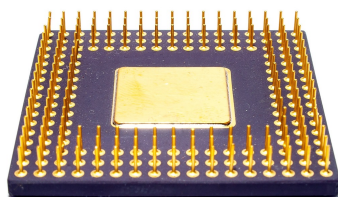
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Monitoring a computing infrastructure



Resources:

- Computing nodes
- Network devices
- Storage
- Appliances



- Availability
- Resource optimization
- Issue detection



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Inventory retrieval

- CLI interface to get inventory from BMC.
- PostgreSQL views for easy access to relevant information (processors, memory, disks, etc...).
- Thanks to check_redfish.py script: plugin for Nagios, NetBox, Icinga2.
- Easy pipeline on the command line with Miller and jq to process JSON data.

```
nicola in ~ at panopticon
→ bmc_inventory show -m nodeBG2 | jq .power_supply | mlr --j2p --barred cut -f id,bay,health_status,name,type,model,serial,manufacturer,capacity_in_watt
+-----+-----+-----+-----+-----+-----+-----+-----+
| id | bay | name | type | model | serial | health_status | capacity_in_watt |
+-----+-----+-----+-----+-----+-----+-----+-----+
| 1.0 | Slot 1 | PSU1 | AC | LENOVO-SP57A86677 | A3DB3B310WA | OK | 2600 |
| 1.1 | Slot 2 | PSU2 | AC | LENOVO-SP57A86677 | A3DB3B310VS | OK | 2600 |
| 1.2 | Slot 3 | PSU3 | AC | LENOVO-SP57A86677 | A3DB3B310VR | OK | 2600 |
| 1.3 | Slot 4 | PSU4 | AC | LENOVO-SP57A86677 | A3DB3B310WC | OK | 2600 |
+-----+-----+-----+-----+-----+-----+-----+-----+
nicola in ~ at panopticon
→
```




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Machines database: Schema

- CLI interface to perform low level operation on each of the 3 main tables.
- CLI commands have comprehensive man pages.
- Schema and attribute values.
- pspg: a pager for PostgreSQL.

```
nicola in ~ at panopticon
→ db schema netaddr | pspg
```

Panopticon: db (/usr/bin/tmux) [Panopticon (ssh) (2)]						
File Search Command Options						
	id	table_name	column_name	data_type	column_default	description
1	1	netaddr	ip	inet	-	IP address
2	2	netaddr	lladdr	macaddr	-	MAC address
3	3	netaddr	hostname	text	-	Optional hostname of the node
4	4	netaddr	machine_id	bigint	-	Foreign key reference to the machines table machine_id
5	5	netaddr	net_id	bigint	-	Primary key of the netaddr table
6	9	netaddr	interface	text	-	Interface name to indentify its type: e.g. private, pu
7						



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Machines database schema

- CLI interface to perform low level operation on each of the 3 main tables.
- CLI commands have comprehensive man pages.
- Schema and attribute values.

```
nicola in ~ at panopticon took 3.2s
→ db show attributes
+-----+
| attribute_name |
+-----+
| category       |
| cluster        |
| health_issue   |
| interface      |
| line           |
| mapped_category|
| project        |
| rack           |
| side           |
+-----+

nicola in ~ at panopticon
→ db show attributes project
+-----+-----+-----+
| project | description | class |
+-----+-----+-----+
| Alice   | Machines for Alice project | SERVER |
| BELLE   | Machines for BELLE project | SERVER |
| ETIC    | Machines for PNRR ETIC project | SERVER |
| ICSC    | Machines for PNRR ICSC project | SERVER |
| N/A     | Undefined project | SERVER |
| SkyNet  | Machines for PRIN SkyNet project | SERVER |
| TeRABIT | Machines for PNRR TeRABIT project | SERVER |
+-----+-----+-----+

main
```



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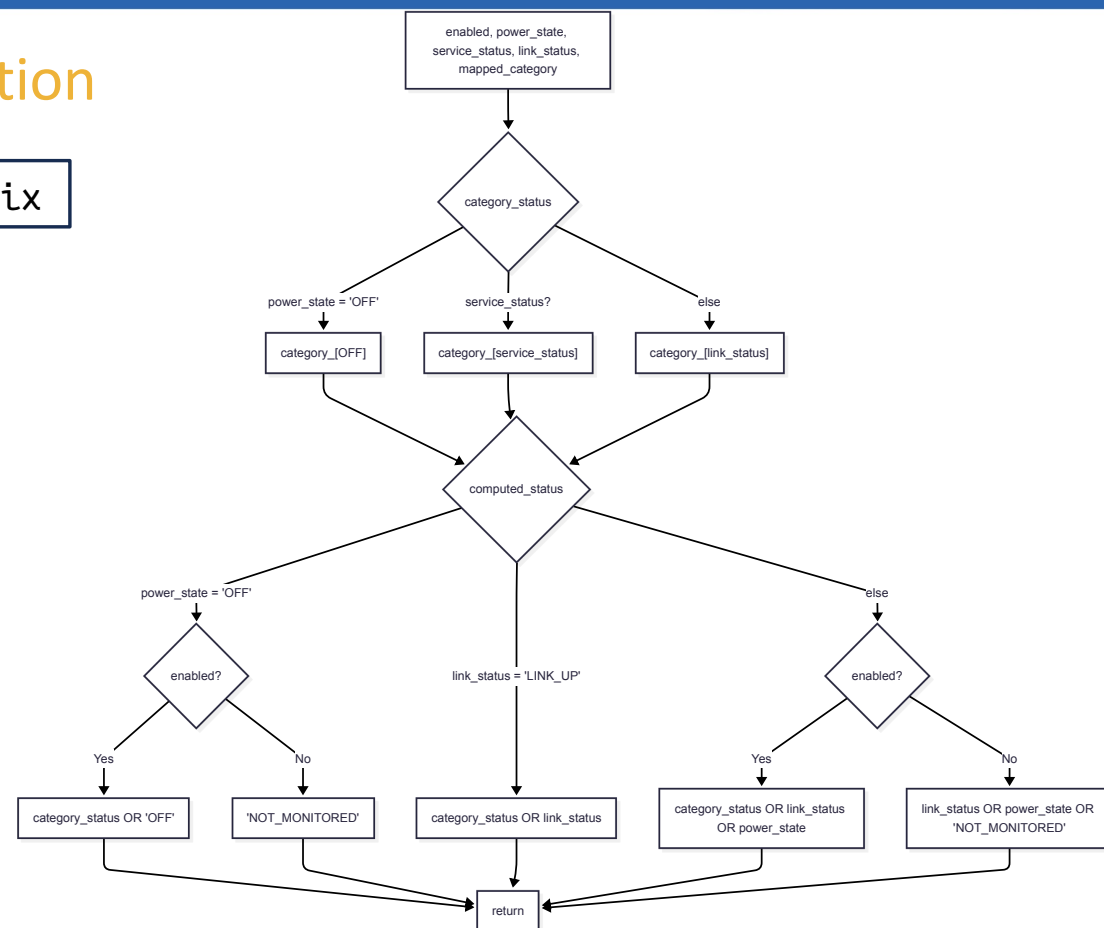
Dashboard design: Status determination

`category_status = mapped_category + status suffix`



`computed_status`

Status Filter		Status legend	
RACKS		N/A	CONDOR IDLE
ROW B			CONDOR RUNNING
RACK 01			KVM UP
			LINK DOWN
			LINK UP
			NOT MONITORED
			POWERED OFF
			POWERED ON
			SRV UP
			STORAGE UP
			YOGA OFF
			YOGA UP
			CRITICAL
			WARNING
RACK 02			
RACK 03			
RACK 04			
RACK 05			
RACK 06			
RACK 07			
RACK 08			
RACK 09			
RACK 10			
RACK 11			
RACK 12			
RACK 13			
RACK 14			





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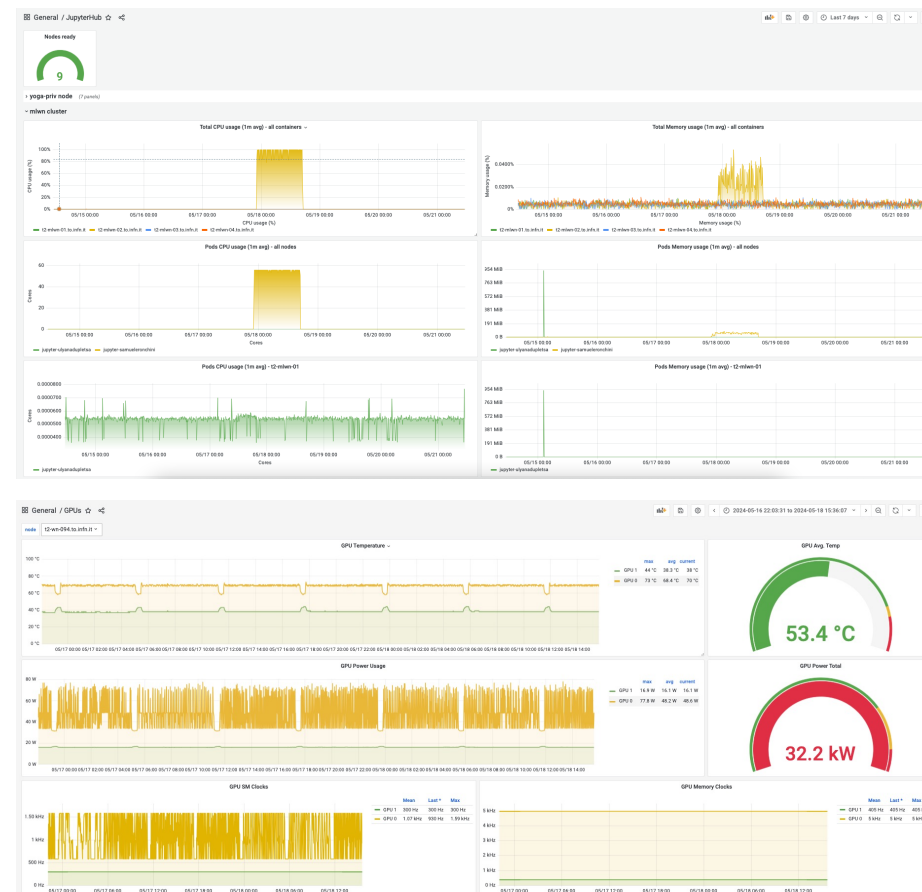


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Yoga cluster

- Prototype for the resources that we intend to provide to the local community.
- It should be combined with INFN Cloud.
- Kubernetes cluster for ML applications.
- JupyterHub interface.
- CPU and GPU resources.
- Monitoring based on Prometheus and Grafana running in kubernetes nodes.

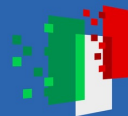




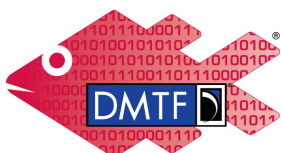
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Redfish



S N M P

- Open standard specification
- Agent-less
- RESTful API
- JSON-based schema
- Features: management, provisioning, monitoring
- Monitoring hardware health: temperature, power, disk I/O
- Logs collection

- Industry standard protocol
- Manager-agent architecture
- Based on MIBs (Management Information Bases)
- Monitoring network devices, CPU/RAM usage, storage
- Real-time alerts for network faults and errors
- Mature and widely adopted in the industry



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Prometheus

- Open source tool with alerting capabilities
- Time-series database
- Collection of data over HTTP (through exporters)
- Widely adopted for reliability and scalability



- Open source platform for creating interactive dashboards
- Supports several data sources
- Notification when alerts are raised in Prometheus



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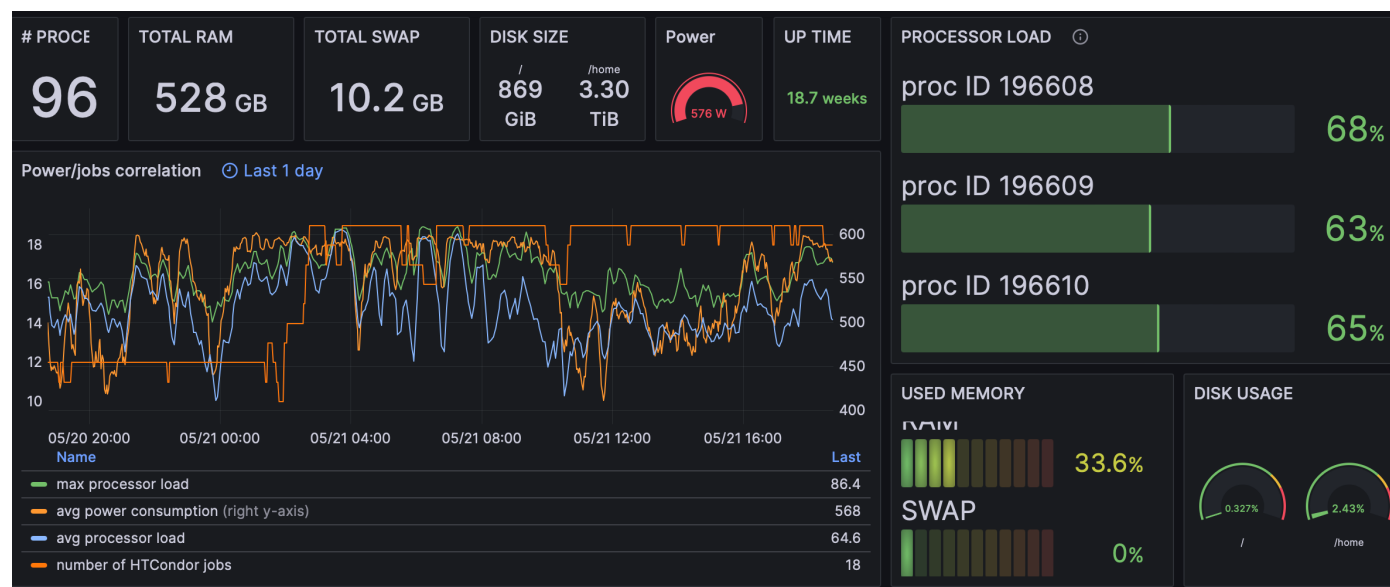
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Use case: Monitoring HTCondor jobs, CPU load, and power consumption

- SNMP tool installed on nodes to collect hardware metrics: CPU, disk, RAM; collect metrics about HTCondor jobs.
- Custom Redfish exporter to collect metrics about power consumption and temperature.
- Data collected by Prometheus and displayed in Grafana: show correlation between power, CPU load, and number of jobs.





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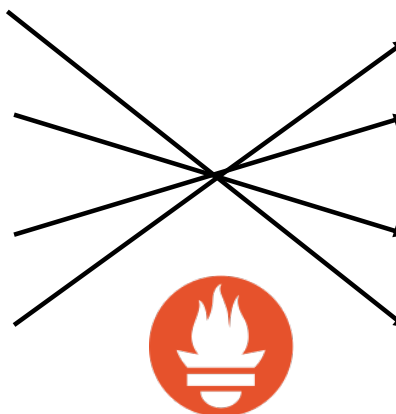


Application

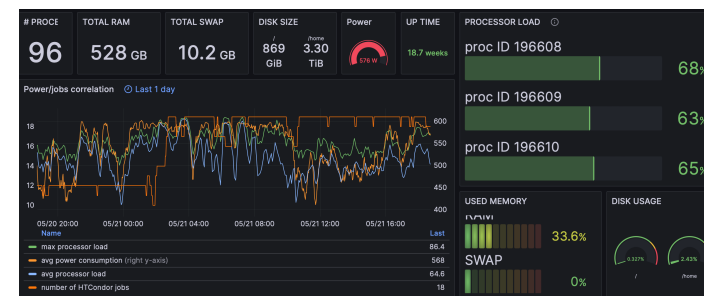
Middleware

Hardware

Base
infrastructure



Prometheus





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Future goals and development:

- Under development Python script for (semi)automatic discovery of metrics paths in Redfish.
- Metrics configuration stored in (Postgres) database.
- Configuration information processed by Julia scripts and loaded into the database.
- Redfish used to retrieve logs and collected by the ELK stack.

```
async def get_power_state(self, management_state):
    if self.vendor == 'DELL':
        uri = '/redfish/v1/Chassis/System.Embedded.1'
    else:
        uri = '/redfish/v1/Chassis/1'
    start_time = time.time()
    try:
        async with self.session.get(self.url_prefix+uri,
                                   ssl=self.ssl,
                                   headers=self.headers_key) as response:
            try:
                json_system = await response.json()
            except Exception:
                _logger.debug(f"cannot retrieve power for {self.mgmt}")
                value = "Unknown"
            else:
                value = json_system.get("PowerState", "Unknown")
        finally:
            result = (self.mgmt, 'PowerState', value)
            self.power_state.labels(mgmt=self.mgmt, ipref=self.ipref, op=
            except aiohttp.ClientConnectorError as e:
                _logger.error(e)
            management_state.labels(mgmt=self.mgmt, ipref=self.ipref, op=sel
    else:
        management_state.labels(mgmt=self.mgmt, ipref=self.ipref, op=sel
    total_time = time.time() - start_time
    self.time += total_time
    self.counter += 1
```

id	machine_id	metrics_spec	uri	polling	created_at	time_modified
1	266	1/Temp/4	/redfish/v1/Chassis	30	2024-05-08 12:19:54.693	2024-05-08 12:32:42.995
2	266	1/Watt/4	/redfish/v1/Chassis	60	2024-05-08 12:34:24.874	2024-05-08 12:34:24.874

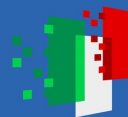
```
alladdr = _find_lladdr(query_lladdr(; header), arp_table, hosts)
@chain alladdr begin
    @subset @passmissing startswith(:ip, r"(192|193|10|.0)\.")
    leftjoin(db_resolve, on=:ip, makeunique=true)
    @rtransform! :hostname = coalesce(AsTable(r"hostname")...)
    @rtransform! :hostname = @coalesce :hostname dig(:ip, hosts)
    @select :ip :lladdr :hostname
    @orderby :ip
end
```



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Computing infrastructure

CTLab (*Computing Technology Lab*):

- New cluster dedicated to ET (*TechZoo*).
- Evaluate new technologies.
- Dedicated heterogeneous computing power on demand.

TeRABIT:

- Network for academic research.
- Upgrade current network to Tb/s.
- Infiniband connection high-bandwidth/low-latency.
- HPC bubbles: HPC resources available close to the user.



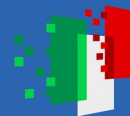
synergy



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What do we have in Turin?

TeRABIT:

- 6xCPU nodes
 - 112-192 cores
 - RAM 8GB(DDR5) minimum/core
 - InfiniBand NDR 400Gbps
- 6xGPU nodes
 - 80GB minimum
 - HBM2e memory per node
- 1xInfiniBand switch 400 Gb/s



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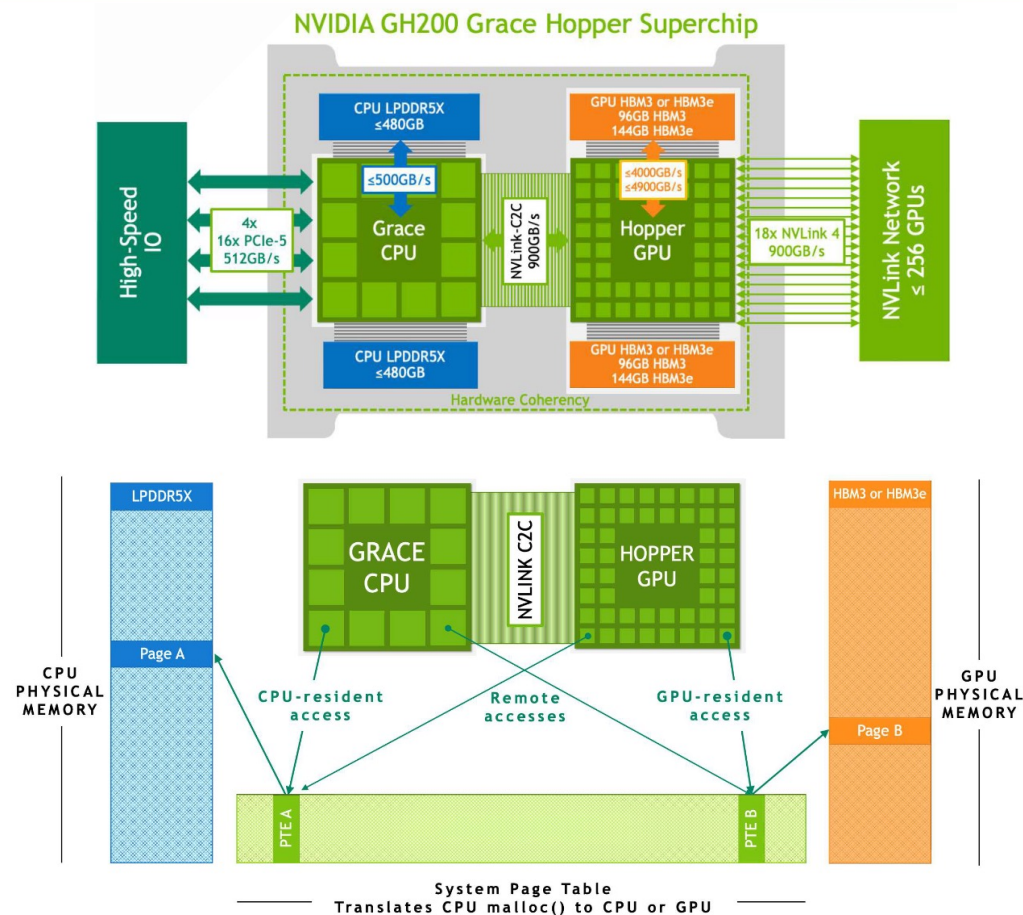


terabit

What do we have in Turin?

Evaluation system, funded by ETIC grant:

- 1×NVIDIA Grace Hopper Superchip
 - CPU+GPU coherent memory model
 - 900 GB/s coherent interface NVLink-C2C
 - Adopted also in Alps Supercomputer @ CSCS
 - 7x higher than x16 PCIe Gen5 bandwidth lanes





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Redfish and Snmp

- **Benefits of Redfish and SNMP**
- **Scalability:** Redfish and SNMP support monitoring of large-scale infrastructures with ease.
- **Interoperability:** Both protocols are widely supported by hardware vendors, ensuring compatibility across different devices and platforms.
- **Real-time Monitoring:** Redfish and SNMP provide real-time insights into hardware and network performance, enabling proactive issue resolution.
- **Standardization:** Redfish and SNMP adhere to industry standards, simplifying integration and automation in infrastructure monitoring workflows.



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Redfish configuration development



- Database initially built from preexisting sources, processing the information with Julia scripts.
- Julia script to verify the initial information.
- At this stage data is imported manually into the database.
- Prometheus configured by exporting the configuration *via* a script.

mgmt	node	hostname	rack	memory	model	processor	serial_number	Valore
1	10.10.2.107	[NULL]	[NULL]	[NULL]	Lenovo SR675	[NULL]	[NULL]	1 one-kvm-59
2	10.10.1.49	nodeAS0	central-storage	8*32GB	Lenovo Think	[NULL]	[NULL]	
3	10.10.1.55	nodeAS1	belle-dsrv-11	8*32GB	Lenovo Think	[NULL]	S4BZS988	
4	10.10.1.48	nodeAR1	alice-srv-03	8*32GB	dell R7425	epyc 7281	[NULL]	
5	10.10.1.29	nodeR9	one-kvm-49	8*8GB	[NULL]	AMD-6320	[NULL]	
6	10.10.1.30	nodeRA	one-kvm-50	8*8GB	[NULL]	AMD-6320	[NULL]	
7	10.10.1.31	nodeRB	one-kvm-51	8*8GB	[NULL]	AMD-6320	[NULL]	
8	10.10.1.32	nodeRC	one-kvm-52	8*8GB	[NULL]	AMD-6320	[NULL]	
9	10.10.1.33	nodeRD	one-kvm-53	8*8GB	[NULL]	AMD-6320	[NULL]	
10	10.10.1.34	nodeRE	one-kvm-54	8*8GB	[NULL]	AMD-6320	[NULL]	
11	10.10.1.35	nodeRF	one-kvm-55	8*8GB	[NULL]	AMD-6320	[NULL]	
12	10.10.1.36	nodeRG	one-kvm-56	8*8GB	[NULL]	AMD-6320	[NULL]	
13	10.10.1.37	nodeRH	one-kvm-57	8*8GB	[NULL]	AMD-6320	[NULL]	
14	10.10.1.38	nodeRK	one-kvm-58	8*8GB	[NULL]	AMD-6320	[NULL]	
15	10.10.1.39	nodeRL	one-kvm-59	8*8GB	[NULL]	AMD-6320	[NULL]	
16	10.10.1.40	nodeRM	one-kvm-60	8*8GB	[NULL]	AMD-6320	[NULL]	
17	10.10.1.41	nodeRN	one-kvm-61	8*8GB	[NULL]	AMD-6320	[NULL]	
18	10.10.1.42	nodeRP	one-kvm-62	8*8GB	[NULL]	AMD-6320	[NULL]	
19	10.10.1.43	nodeRR	one2-kvm-101	8*8GB	[NULL]	AMD-6320	[NULL]	
20	10.10.1.44	nodeRS	one-kvm-64	8*8GB	[NULL]	AMD-6320	[NULL]	
21	10.10.1.45	nodeRT	one2-kvm-102	8*8GB	[NULL]	AMD-6320	[NULL]	
22	10.10.1.46	nodeRU	one2-kvm-103	8*8GB	[NULL]	AMD-6320	[NULL]	
23	10.10.1.47	nodeRV	one2-kvm-104	8*8GB	[NULL]	AMD-6320	[NULL]	
24	10.10.1.56	nodeAS2	belle-dsrv-12	8*32GB	Lenovo Think	[NULL]	S4BZS989	
25	10.10.1.59	nodeT1	glfs-srv-08	8*8GB	dell R715	AMD-6320	[NULL]	
26	10.10.1.91	nodeP0	one-san-06	6*4GB	dellR720	[NULL]	[NULL]	

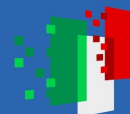
id	machine_id	metrics_spec	metrics_uri	polling	created_at	time_modified
1	1	266 1/Temp/4	/redfish/v1/Chassis	30	2024-05-08 12:19:54.653	2024-05-08 12:21:42.995
2	2	266 1/Watt/4	/redfish/v1/Chassis	60	2024-05-08 12:34:24.874	2024-05-08 12:34:24.874



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Future goals and development:

- Database of machines for configuration of Redfish exporter.
- Python script for (semi)automatic discovery of metrics paths.
- Redfish used to retrieve logs and collected by the ELK stack.

```
function find_multiple_addr!(df::AbstractDataFrame)
    addr_types(n) = map(("ip_$(i)" for i in 1:n)) do x
        replace(x, r"^ip_1" => "primary", r"^ip_2" => "sec")
    end
    @chain df begin
        @subset begin
            :source in ["left_only", "both"] && startswith(
                @kwarg view=true
            )
        end
        @groupby :lladdr
        transform!(nrow => :naddr)
        @subset(:naddr > 1; view=true)
        @aside @debug "naddr: $(length(._naddr))"
        @transform! :type = addr_types(length(:naddr))
        @orderby :mgmt :ip
    end
end
```

```
async def get_power_state(self, management_state):
    if self.vendor == 'DELL':
        uri = '/redfish/v1/Chassis/System.Embedded.1'
    else:
        uri = '/redfish/v1/Chassis/1'
    start_time = time.time()
    try:
        async with self.session.get(self.url_prefix+uri,
                                    ssl=self.ssl,
                                    headers=self.headers_key) as response:
            try:
                json_system = await response.json()
            except Exception:
                _logger.debug(f"cannot retrieve power for {self.mgmt}")
                value = "Unknown"
            else:
                value = json_system.get("PowerState", "Unknown")
        finally:
            You, 2 months ago • Fix unknown machines
            result = (self.mgmt, 'PowerState', value)
            _logger.debug(result)
        self.power_state.labels(mgmt=self.mgmt, ipref=self.ipref, apc=self.apc).state(result[2])
    except aiohttp.ClientConnectorError as e:
        _logger.error(e)
        management_state.labels(mgmt=self.mgmt, ipref=self.ipref, apc=self.apc).state("DOWN")
    else:
        management_state.labels(mgmt=self.mgmt, ipref=self.ipref, apc=self.apc).state("UP")
    total_time = time.time() - start_time
    self.ttime += total_time
    self.counter += 1
```




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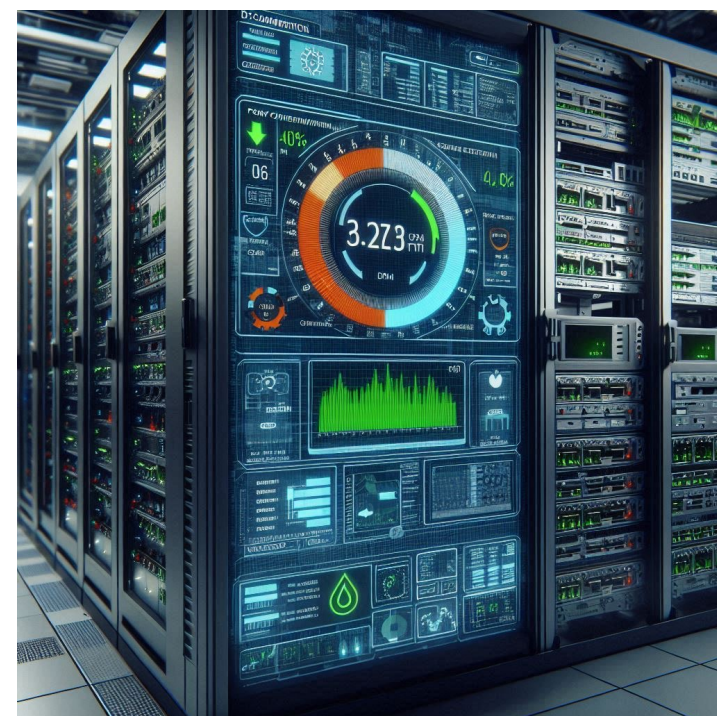


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Monitoring a Computing Infrastructure

- Ensure availability
- Performance optimization
- Detect issues early
- Security

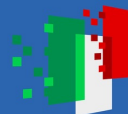




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Monitoring a Computing Infrastructure

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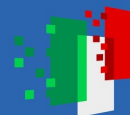
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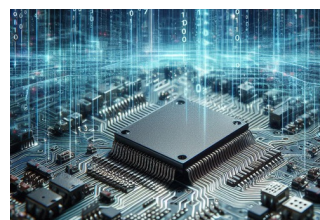
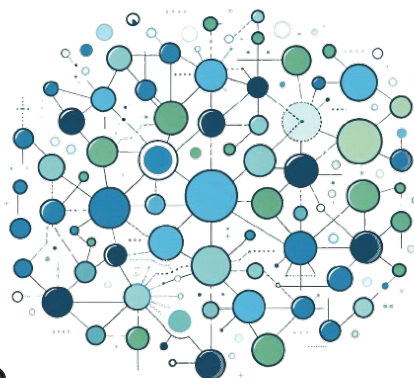
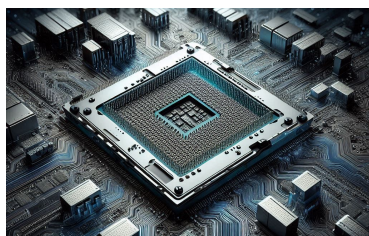
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Monitoring a Computing Infrastructure



Availability & Issue detection

Resource optimization

