







Monitoring resources of a computing infrastructure with Redfish and SNMP

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Palau (SS), Italy

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Outline

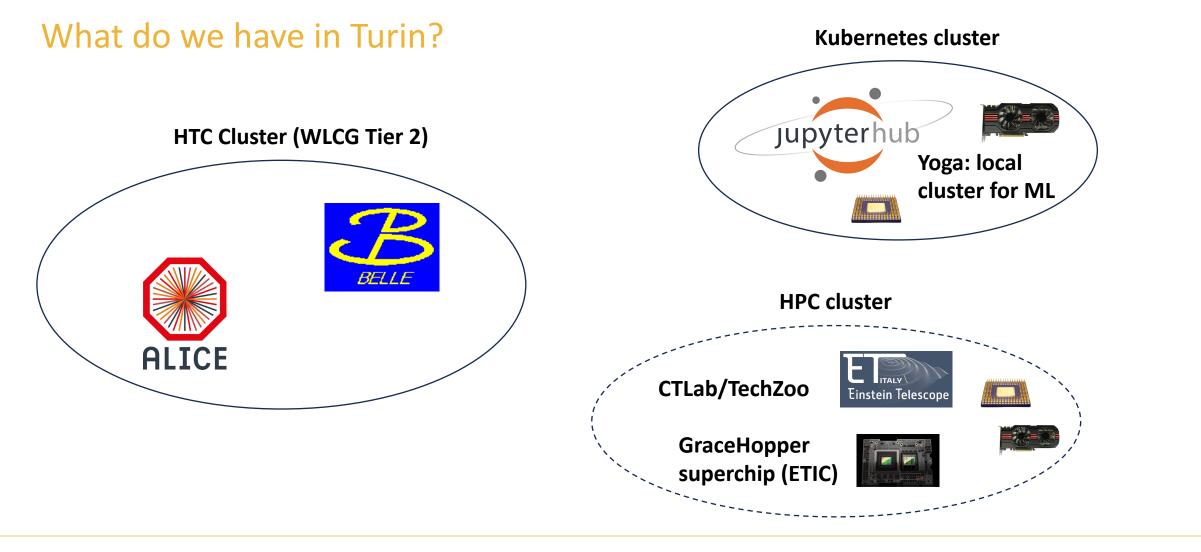
- Motivation: current status of Turin INFN resources and future developments goals.
- Monitoring tools and techniques.
- Test application and current status: correlate power consumption to CPU load and number of HTCondor jobs.



















What do we have in Turin?

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.

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- Infiniband connection high-bandwidth/lowlatency.
- HPC bubbles: HPC resources available close to the user.



synergy









What do we have in Turin?

CTLab/TechZoo

TeRABIT





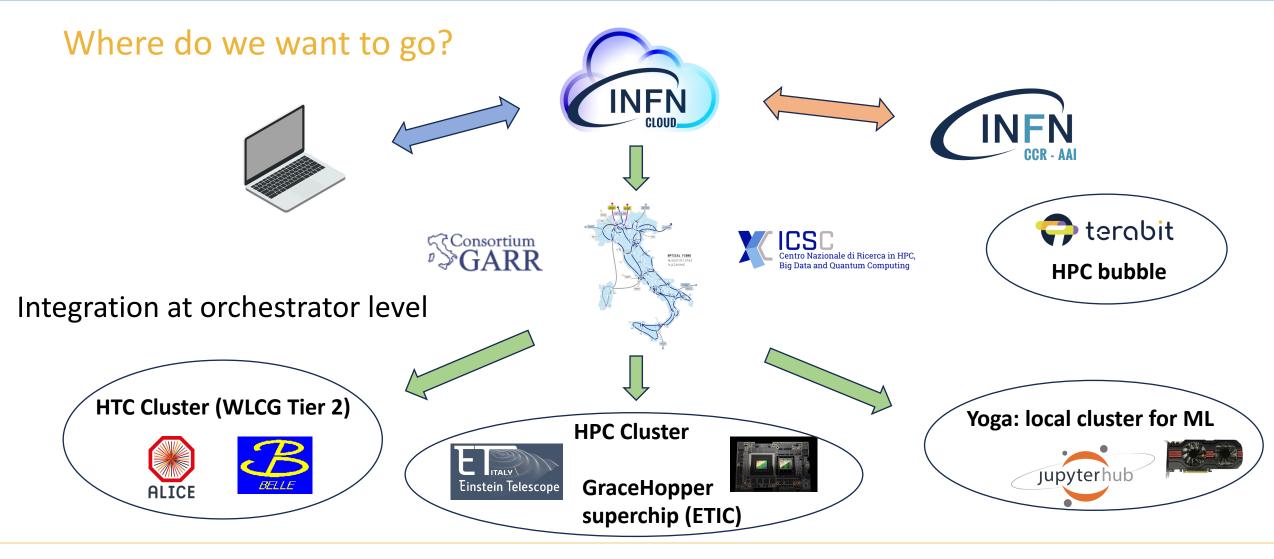
L. Tabasso











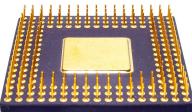


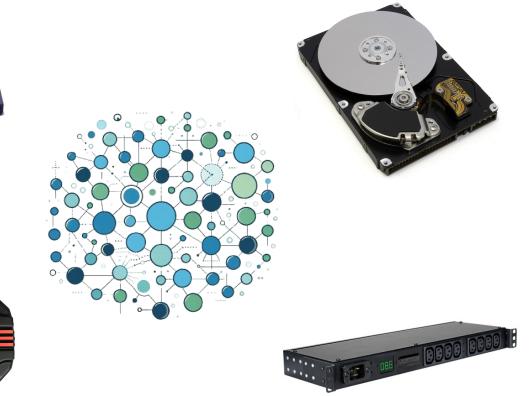






Monitoring a Computing Infrastructure





Resources:

- Computing nodes
- Network devices
- Storage

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• (PDU/UPS)

Availability Resource optimization Issue detection









Tools and protocols for monitoring



<u>Nagios</u>[®]



SNMP









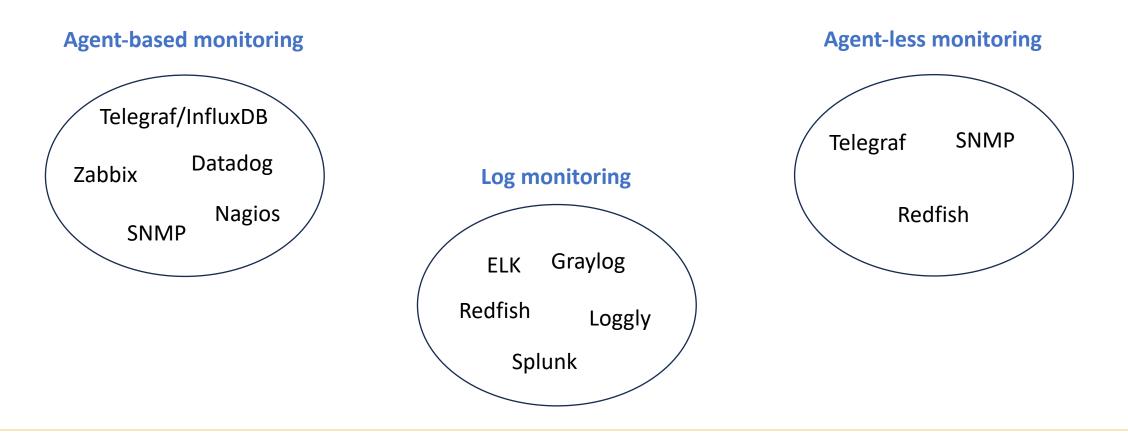




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Monitoring techniques



TeRABIT











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



SNMP

• 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













- 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









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 about power consumption and temperature.
- Data collected by Prometheus and displayed in Grafana: show correlation between power, CPU load, and number of jobs.

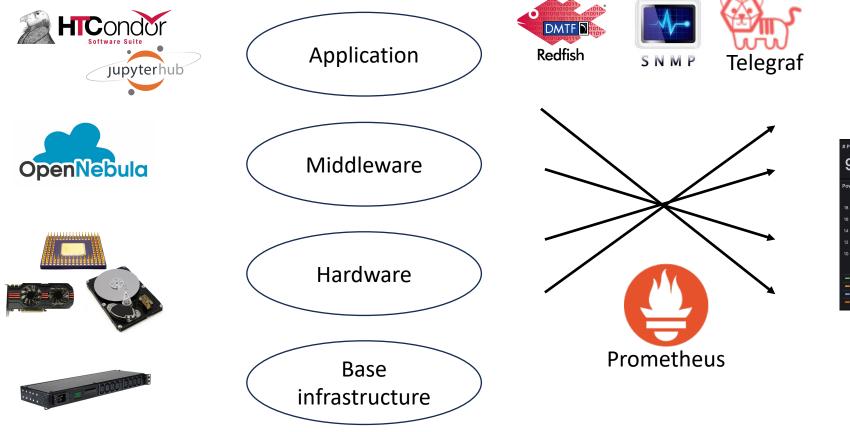














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- number of	f HTCondor jobs			078			



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Finanziato dall'Unione europea **NextGenerationEU**

Future goals and development:

discovery of metrics paths in Redfish.

Under development Python script for (semi)automatic

Metrics configuration stored in (Postgres) database.







/nc 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() - D async with self.session.get(self.url_prefix+uri ssl=self.ssl, headers=self.headers_key) as respons json_system = await response.json() except Exception: _loager.debug(f"cannot retrieve power for {self.mamt}") value = "Unknown value = json_system.get("PowerState", "Unknown" finally: result = (self.mgmt, 'PowerState', value) _logger.debug(result) self.power_state.labels(mgmt=self.mgmt, ipref=self.ipref, ap except aiohttp.ClientConnectorError as e: _logger.error(e) management_state.labels(mgmt=self.mgmt, ipref=self.ipref, apc=se else: management_state.labels(mgmt=self.mgmt, ipref=self.ipref, apc=se total_time = time.time() - start_time self.ttime += total_time self.counter += 1

Configuration information processed by Julia scripts and loaded into the database. .. 🤚 Prog... 🗙 Redfish used to retrieve logs and collected by the ELK 🗖 СРСТО

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stack.









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.













Conclusions



- Turin infrastructure is growing and new machines for different application clusters are being installed.
- Monitoring is important to keep track of resource usage, power consumption, fault detection, from all layers (infrastructure to software).
- Current development based on a custom solution using Redfish and SNMP for data collection; Prometheus and Grafana for data ingestion and visualisation.
- Custom tools and scripts written in different languages: *e.g.* the Redfish exporter and database manipulation scripts.









BACKUP SLIDES

TeRABIT









What do we have in Turin?

CTLab (Computing Technology Lab):

- 4x Dell PowerEdge R7525:
 - 2×(AMD EPYC 7313 3.0 GHz 16 cores)
 - $\circ~$ 1TB RDIMM, 3200 MT/s
 - 2×(PCIe Gen4 slots)+2×(PCIe Gen4 GPU slot DW)
 - $2 \times (SSD 960 \text{ GB} \text{ with Endurance DWPD} \ge 0.9)$
- GPUs DW:
 - 2×(AMD MI100, 32GB)
 - \circ 1×(NVIDIA A16, 4×16GB)
 - o 2×(NVIDIA A5000, 24GB)
- 3×Lenovo SR675v3
 - 2×(AMD EPYC 9124 3.0 GHz 16 cores)
 - o 1TB RAM (expandable)
 - PCIe Gen5 slots

- InfiniBand connectivity
- NVIDIA ConnectX-7 NDR OSFP400
- GPUs DW
 - 2×(NVIDIA L40S 48GB)

Possibly more... Extra ARM servers funded by ETIC









What do we have in Turin?

TeRABIT:

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







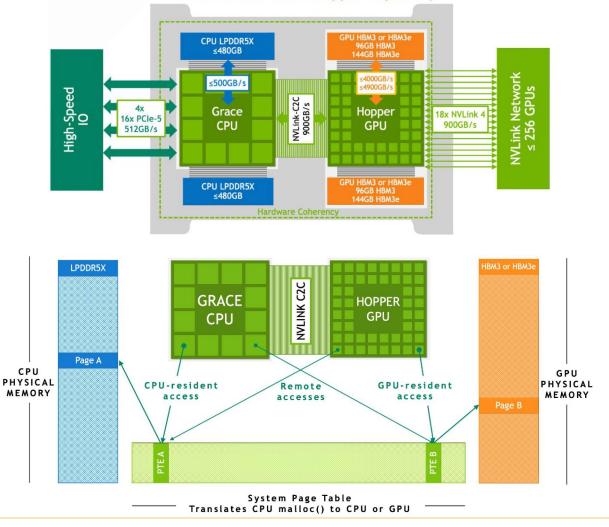


What do we have in Turin?

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

NVIDIA GH200 Grace Hopper Superchip











Redfish and Snmp

- Benefits of Redfish and SNMP
- **Scalability**: Redfish and SNMP support monitoring of largescale 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.









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.

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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.













Monitoring a Computing Infrastructure

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











Monitoring a Computing Infrastructure

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



https://home.web.cern.ch/science/computing

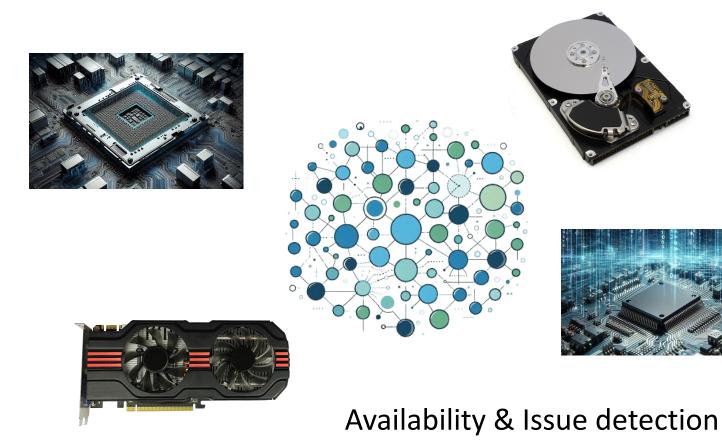








Monitoring a Computing Infrastructure



Resource optimization

