

IDENTIFICATION

Course code : ESI-SPI-CI-IN4-S8-UE1-EC2
ECTS : 2

DURATION

Lectures : 4
Tutorial classes : 6
Labs : 6
Total : 16

Project :
Personnal work :

ASSESSMENT

Continuous assessments and practical session reports.

TEACHING MATERIALS

Slide decks and worksheets for tutorials and practical sessions.

LANGUAGE

English

CONTACT

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UE : UE8-SYSRES

COURSE : System Administration : Storage and Infrastructure Monitoring

SCOPE OF THE COURSE

OBJECTIVES

Acquire the operational skills necessary for the operation, monitoring, and maintenance of a production system infrastructure. This course covers two complementary areas : the design of high-availability storage architectures (SAN, NAS, distributed storage) and the implementation of comprehensive information system monitoring, enabling proactive anomaly detection and service continuity assurance.

COMPETENCE AND SKILLS

- Design and deploy a storage architecture suited to the performance, availability, and cost constraints of a production infrastructure
- Evaluate and optimize the performance of a high-availability storage network (iSCSI, NFS, SAN) using benchmarking and I/O analysis tools
- Implement a comprehensive monitoring solution for an information system : metric collection, alerting, centralized logging, and dashboards
- Identify and diagnose anomalies in a system infrastructure from collected metrics and logs, and propose corrective actions
- Compare and select a virtualization or containerization solution suited to an operational need, considering the advantages and limitations of each approach
- Understand cloud computing paradigms (IaaS, PaaS, SaaS) and identify use cases justifying a cloud deployment

PROGRAM

— Storage Architectures :

- Overview of storage types : DAS, NAS, SAN — use cases and selection criteria.
- Network storage protocols : iSCSI, NFS, SMB/CIFS, Fibre Channel.
- High-availability storage : RAID, synchronous/asynchronous replication, *failover*.
- Distributed storage : introduction to Ceph and GlusterFS — architecture and use cases.
- Performance evaluation : IOPS, throughput, latency ; benchmarking tools (fio, iotop).
- Backup and restore strategies : 3-2-1 rule, tools (Bacula, Restic, Veeam).

— Virtualization and Containerization — Operational Overview :

- Overview of Type 1 and Type 2 hypervisors ; comparison with containerization.
- Operational advantages and drawbacks of virtualized servers : density, isolation, portability, overhead.
- Comparison of solutions : Proxmox VE, VMware ESXi, KVM, Docker, Kubernetes.

- Selection criteria based on context : security constraints, performance, budget.
- **Cloud Computing Paradigms :**
 - Service models : IaaS, PaaS, SaaS, FaaS — definitions and use cases.
 - Deployment models : public, private, hybrid, multi-cloud.
 - Major cloud providers : AWS, Azure, GCP — overview of services.
 - Shared responsibility model for cloud security.
- **Information System Monitoring and Supervision :**
 - Supervision challenges : availability, performance, security, compliance.
 - System and network metric collection : CPU, memory, disk, bandwidth.
 - Monitoring tools : Prometheus, Grafana, Zabbix, Nagios, Netdata.
 - Alerting : threshold definition, escalation, on-call management (Pager-Duty, Alertmanager).
 - Centralized logging : collection and aggregation of logs (Syslog, journald, ELK Stack, Loki).
 - Operational dashboards : design and best practices.
- **Anomaly Detection and Preventive Maintenance :**
 - Identifying degradation indicators : saturation, abnormal latency, recurring errors.
 - Event correlation and incident diagnosis from logs and metrics.
 - Preventive maintenance : update planning, patch management, load testing.
 - Incident management : escalation procedures, post-mortem, continuous improvement.

BIBLIOGRAPHY

- Evi Nemeth et al. - *UNIX and Linux System Administration Handbook* - Addison-Wesley, 5th ed., 2017
- The SysAdmin Handbook - Simple Talk Publishing, 2010
- Prometheus Documentation : <https://prometheus.io/docs/>
- Grafana Documentation : <https://grafana.com/docs/>
- Zabbix Documentation : <https://www.zabbix.com/documentation/>
- Elastic Stack (ELK) Documentation : <https://www.elastic.co/guide/>
- Ceph Documentation : <https://docs.ceph.com>
- ANSSI - *Recommendations for Logging Information Systems* : <https://www.ssi.gouv.fr/guide/>

REQUIREMENTS

- **SR052 / SYSRES 502 - Operating System and Command Language (S5) :** Linux administration, process management, file systems, Bash scripting.
- **SR062 / SYSRES 602 - System Administration 1 (S6) :** system services, user management, introduction to monitoring.

- **SR702 / SYSRES 702 - System Administration 2 (S7)** : orchestration, containers, cloud services, LDAP, DNS — direct prerequisite.
- **Expected cross-disciplinary skills :**
 - Advanced Linux administration : systemd, networking, storage, LVM
 - Bash and Python scripting for automation
 - Understanding of TCP/IP network architectures
 - Ability to read technical documentation in English