Next Generation Cloud Computing Reliability: Issues and Challenges

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Introduction

- Cloud computing is widely recognized for its cost savings, scaling and for accelerating business innovation.
- Current deployment of Cloud usage is dominated by none-critical applications
- Critical applications with stringent reliability assurance and resilience requirements have not really adopted Cloud
  - Smart grid, Banking
  - Mission-critical applications and data

Failures in Cloud Computing

- Failures in Cloud infrastructures
  - can last from hours to days
  - often cascade to other healthy system components.
  - Failures can escalate and devastatingly impact system operation, thus causing critical failures.
  - A cascade of failures may be triggered leading to large-scale service disruptions with far-reaching consequences.

Failures in Cloud Computing…

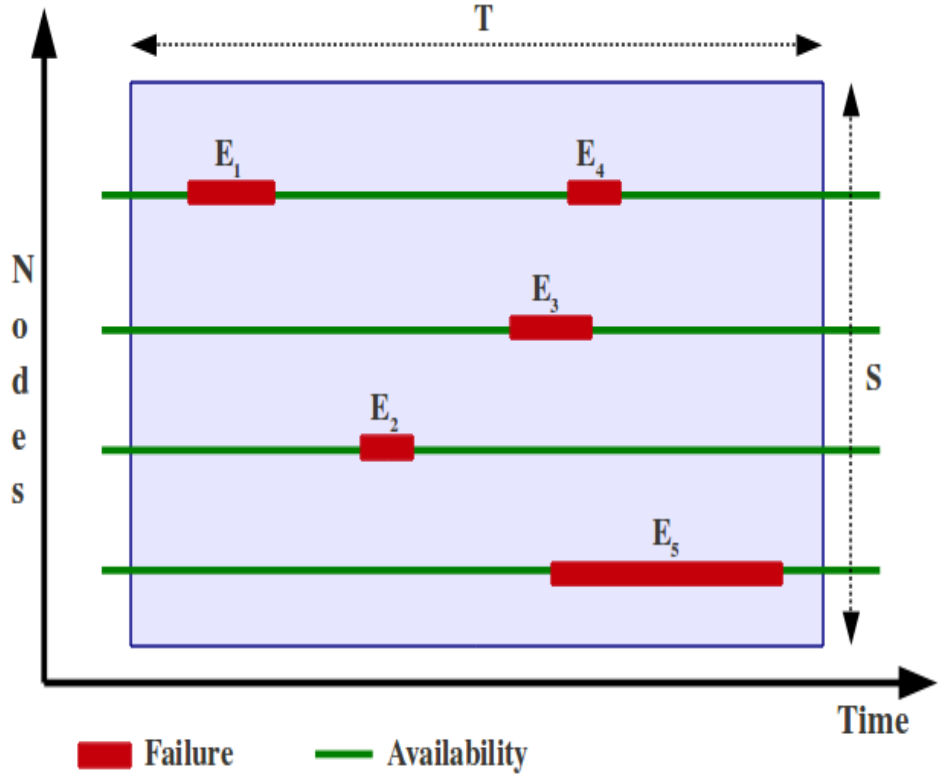
- Root causes of failures
  - Component faults: Hardware (e.g., disk failure), and software and network failures
  - Human-machine interaction faults,
  - Reliability due to security attacks (e.g., Insider attack and Malware attack)
  - Hybrid reliability issue: Combination of component faults, security attacks and human-machine interaction faults

Example of Recent Cloud Failures

- Failure in Elastic Block Store (EBS) due to a network configuration problem
  - Triggered large and unnecessary data replication that resulted in major service unavailability in EBS
  - The failure cascaded and affected
    - Amazon's Elastic Compute Cloud (EC2) and
    - Relational Database Service (RDS)

Failure Correlation

Correlation in Failures → *overlapped failures*



Temporal correlation: the failure rate is time-dependent and some periodic failure patterns can be observed in different time-scales

Spatial correlation : multiple failures occur on different nodes within a short time interval

Current Solution

- R*esource redundancy* is the most common approach
- Redundant components
  - Incur additional cost of purchasing spare components,
  - Hide component failures and can potentially lead to complete outages as the impact of failures escalates,
  - Failures can be partial and the culmination of a collection of partial failures will lead to a major server failure.
  - Power and cooling requirements of the redundant resources contribute to the increased cost of the data centre as well as eco-footprint.

Open Challenges

- Reliability of Cloud computing becomes important with the emergency of large-scale next generation application
  - Internet of Things (IoT)
  - Big Data
  - Critical infrastructures (e.g., smart grid)
- Open Challenge
  - Develop mechanisms that can rapidly recognize and subsequently repair failures.
  - Model for analyses of reliability of Cloud computing.

Publications

- Bahman Javadi, Richard Sinnott and **Jemal Abawajy** (2015), Scheduling of Scientific Workflows in Failure-Prone Hybrid Cloud Systems, Concurrency and Computation: Practice and Experience (John Wiley & Sons, Ltd., ISSN: 1532-0634, Accepted).
- Bahman Javadi, **Jemal Abawajy** and Rajkumar Buyya (2012), Failure-aware Resource Provisioning for Hybrid Cloud Infrastructure, *Journal of Parallel and Distributed Computing*, Volume 72, Issue 10, October 2012, Pages 1318-1331
- B. Javadi, **J. Abawajy**, R. Sinnott (2012), Hybrid Cloud Resource Provisioning Policy in the Presence of Resource Failures, 4th IEEE International Conference on Cloud Computing Technology and Science (IEEE CloudCom 2012), Taipei, Taiwan, December 03-06, 2012. [**Best paper award**]

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Thank You...

Collaborative Work

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