Even More Metrics ...

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1 Network Traffic

Network Metrics

Network Communication
- Throughput – with networks called bandwidth.
- Latency.
- Jitter.
- Packet loss.

Network Services
- Connections per second.
- Transactions per second.
- Maximum concurrent connections.

2 Reliability and Availability

Reliability and Availability Metrics

Reliability
- Probability of errors
- Mean time between errors – error-free seconds

Availability
- \( \text{availability} = \frac{\text{uptime}}{\text{totaltime}} \)
- Mean uptime – Mean Time To Failure (MTTF)
- Mean downtime – Mean Time To Repair (MTTR)
- MTTF is often better indicator than availability (think short uptimes and extremely short downtimes)
3 Computing Infrastructure Capacity

Cloud Metrics

Scalability
The ability to adjust available resources.

Expressing scalability
- Maximum resource allocation limits
- Easy in private cloud
- But how about public cloud?
- Resource allocation granularity
- Acquisition and release time
  - Technical
  - Accounting

Elasticity
The ability to use scalability to address changing resource demands.

Expressing elasticity
- Average or total time to move from under or over provisioned
- Average or total amount of under or over provisioned resources
- In reaction to various workload fluctuation patterns
  - Gradual up or down
  - Regular fluctuations
  - You have been slashdotted!
- Converting to money?
  - Cost of under vs over provisioning
  - Bunch of estimates
    - Apple 2015 App Store 10-12 hours down estimated 25M USD
    - Amazon 2017 S3 Service 3-4 hours down estimated 150M USD
    - Amazon 2018 Store 12-15 minutes down estimated 3M USD

Look at the paper by Herbst et al.: Elasticity in Cloud Computing ...
https://www.usenix.org/conference/icac13/technical-sessions/presentation/herbst. Examine Figure 2 for intuitive definition of overprovisioning and underprovisioning.

4 Information Retrieval Functionality

Information Retrieval Metrics

Precision
Share of correct results in total results delivered.

\[
\text{precision} = \frac{\text{truepositive}}{\text{truepositive} + \text{falsepositive}}
\]

Recall

1Based on Herbst et al.: Elasticity in Cloud Computing ...
2Based on Herbst et al.: Elasticity in Cloud Computing ...
Share of correct results delivered in total correct results.

\[
\text{recall} = \frac{\text{truepositive}}{\text{truepositive} + \text{falsenegative}}
\]

**Accuracy**
Share of correctly classified results.

\[
\text{accuracy} = \frac{\text{truepositive} + \text{truenegative}}{\text{all}}
\]

5 More ...

... Think About More
- Test coverage metrics?
- Energy efficiency metrics?
- Interface usability metrics?
- Artificial intelligence metrics?
  - Speed of learning
  - Quality of decision
- ...