

DEMYSTIFYING THE RELIABILITY OF CLOUD SERVICES

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THEME



- ❖ Many users are suspicious of cloud services reliability
- ❖ Many service providers are not confident of their risk analyses for cloud services SLAs
- ❖ A consistent, unified approach to cloud services reliability is valuable
- ❖ Tools for service reliability engineering readily apply

OVERVIEW



- ❖ Some examples of cloud services
- ❖ How should reliability of cloud services be described?
- ❖ Modeling cloud services reliability
- ❖ Cloud services SLA risk analysis
- ❖ Conclusion

CLOUD SERVICES

EXAMPLES

- ❖ File system backup
- ❖ SaaS
 - Remote execution of applications
- ❖ Remote FTP
 - Dropbox™-like services

CLOUD SERVICES

RELIABILITY

- ❖ These are on-demand services
 - Accessed via transactions
- ❖ To understand reliability, you need to understand the user requirements
 - Failures are violations of the user requirements
 - Reliability engineering concerns frequency and duration of failures and outages

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USER REQUIREMENTS

- ❖ Get at my data when I want to
 - And unauthorized access prevented
- ❖ Uninterrupted upload and download
- ❖ Uninterrupted computation
- ❖ Data are secure and uncorrupted

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RELIABILITY REQUIREMENTS

- ❖ Each user requirement gives rise to one or more reliability requirements
 - How often are the failure modes in the user requirement permitted to occur?
 - For how long are outage conditions permitted to persist?

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FAILURE MODES

- ❖ Can't access stored data
 - Including executables

- ❖ Interruptions
 - Uploads
 - Downloads
 - Executions

- ❖ Delays

- ❖ Errors

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FAILURE MECHANISMS

- ❖ Loss of some shared resource(s)
 - Servers
 - WAN
 - LAN
 - Local interfaces

- ❖ CSP goes out of business

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RELIABILITY: KEY CONCEPT

- ❖ In order to meet the service's requirements, the cloud infrastructure needs to configure itself in specific ways to deliver the service
- ❖ Frequency and duration of cloud service failures/outages is related to the frequency and duration of infrastructure failures/outages

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RELIABILITY MODELING

- ❖ Make these connections explicit
- ❖ Attach numbers based on understanding of the infrastructure hardware and software
 - SDN, NFV, ... are merely different technologies enabling cloud services
 - Even virtualization needs a physical and software infrastructure

EXAMPLE

ENTERPRISE DATA BACKUP



- ❖ Service: off-site backup for enterprise data
- ❖ Features
 - Many users
 - Many databases
 - Service provider decides where to store

EXAMPLE

ENTERPRISE DATA BACKUP



❖ User requirements

- ❑ Any user may request access to his/her data at any time
- ❑ Any user may request upload or download
- ❑ Interruptions limited
- ❑ Delays limited
- ❑ User facilities must be freed up after session is complete

EXAMPLE

ENTERPRISE DATA BACKUP

❖ Reliability requirements examples

□ Accessibility

- + Probability that a user is able to access his/her data at any time is ≥ 0.9995
- + Probability that a user can access data he/she is not authorized to is ≤ 0.0001

□ Continuity

- + Probability that a download or upload is interrupted is ≤ 0.001

□ Release

- + Probability that the service provider does not free up the user's facilities is ≤ 0.00001

EXAMPLE

ENTERPRISE DATA BACKUP

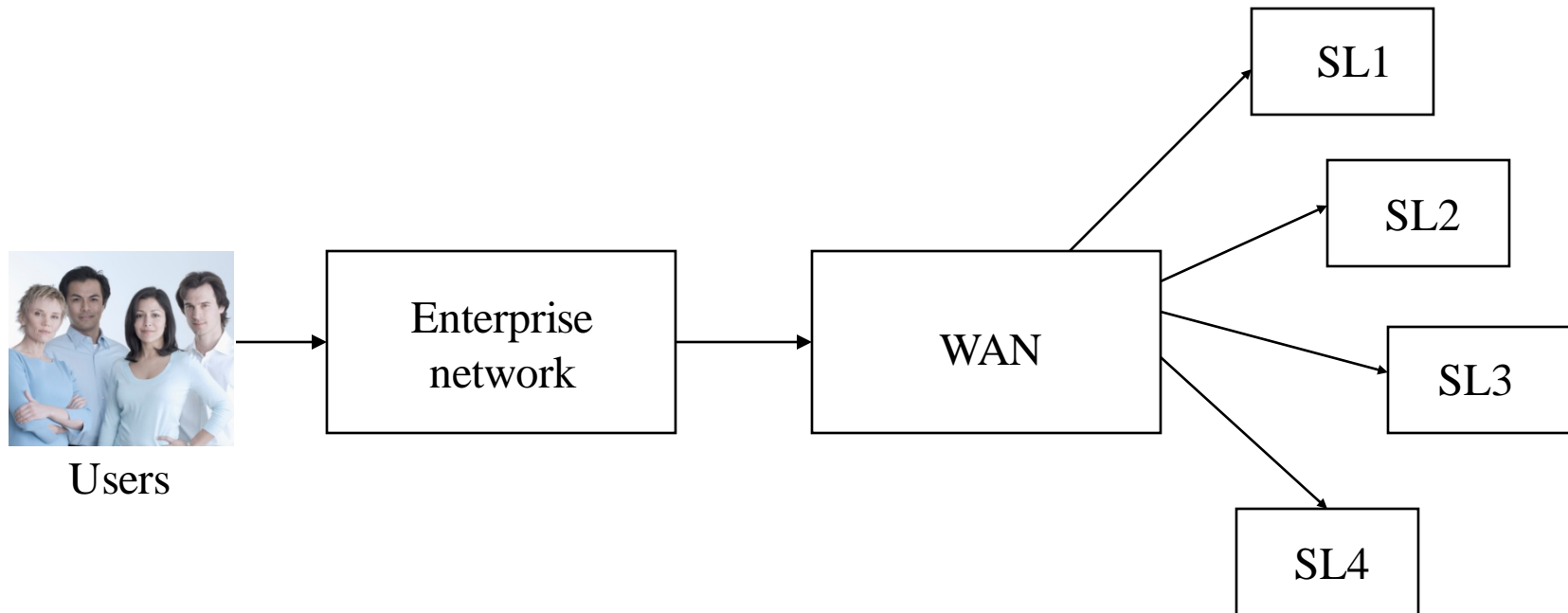


- ❖ Reliability requirements could be aggregated
 - Requirement for an entire group of users rather than by individual user
 - Makes it more difficult to discern individual user performance

EXAMPLE

ENTERPRISE DATA BACKUP

RELIABILITY MODEL



EXAMPLE

ENTERPRISE DATA BACKUP



- ❖ Number and location of storage sites may change from time to time
- ❖ In this example, each storage site contains all the data
- ❖ WAN may not be totally within the control of the cloud storage service provider
 - Contracted from some other network provider

EXAMPLE

ENTERPRISE DATA BACKUP

- ❖ All of this “at time t ”
- ❖ $P\{\text{access data}\} =$
 $P\{\text{user facility working}\} \times P\{\text{reach}$
 $\text{WAN thru enterprise network}\} \times$
 $[P\{\text{reach SL1 thru WAN \& SL1 works}\}$
 $+ \dots + P\{\text{reach SL4 thru WAN \& SL4}$
 $\text{works}\}]$

EXAMPLE

ENTERPRISE DATA BACKUP

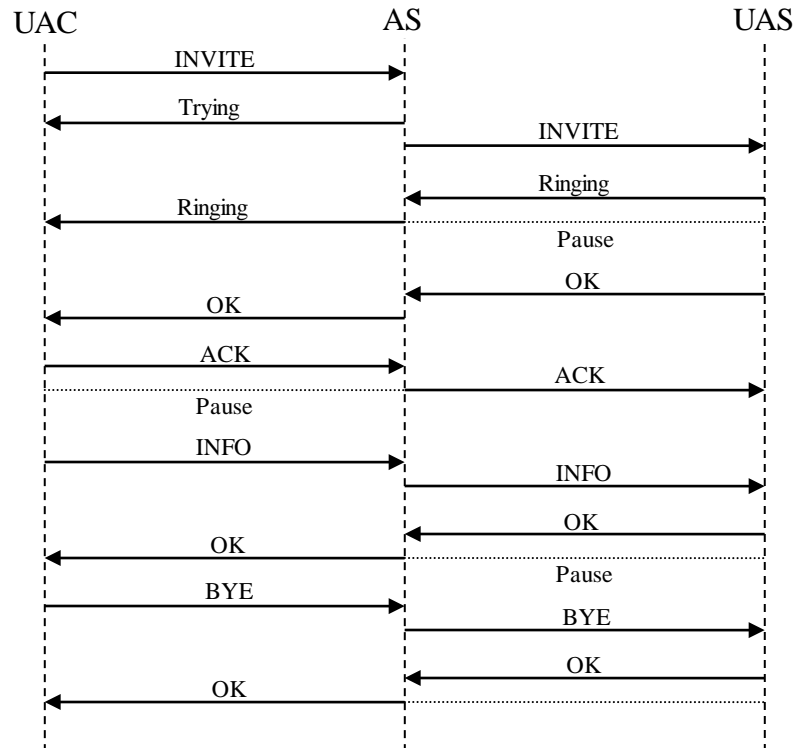


- ❖ Each term may involve additional modeling
- ❖ Independence may or may not be appropriate
- ❖ Service functional decomposition can be a useful tool

EXAMPLE

SERVICE FUNCTIONAL DECOMPOSITION

VoIP with SIP



User Agent Client
Application Server
User Agent Server

EXAMPLE

ENTERPRISE DATA BACKUP

- ❖ Similar models can be constructed for the interruptions failures and the release failures
- ❖ As with all reliability models, simplifications and assumptions are made
 - WAN modeling involves network capacity and traffic demand

FULFILLING THE PROMISE OF SERVICE RELIABILITY IN EMERGING TECHNOLOGY-BASED NETWORKS

The industry ~~needs~~ has a set of reliability metrics and terminology that are common across the network for which individual service availability requirements can be specified



FULFILLING THE PROMISE OF SERVICE RELIABILITY IN EMERGING-TECHNOLOGY-BASED NETWORKS

- ❖ Service customers don't know and don't care what technologies are being used to deliver the service
 - Even when technologies change (e. g., SDN)
 - Enterprises and individuals may have different attitudes

- ❖ The service provider is responsible for ensuring that their infrastructure is capable of delivering reliable service
 - SLA

CLOUD SERVICES

SLA RISK ANALYSIS

- ❖ SLAs for enterprise services are common
- ❖ SLAs for cloud services are riskier
 - Reliability has been less well characterized

COMMON RELIABILITY METRICS AND TERMINOLOGY



- ❖ Transaction-based services
- ❖ Engineering foundations exist
 - CQR 2004-2007
 - Two papers in QTQM
 - Chapter in a forthcoming book

CONCLUSION

- ❖ Conceptually straightforward
 - Key is understanding customer reliability requirements for the cloud service
 - + Accessibility
 - + Continuity/Fulfillment
 - + Release

- ❖ Execution can be challenging
 - Infrastructure models
 - Networks with unreliable elements