Facing adversity: from the study of new technologies to simulation

Chidung Lac, Orange Labs

Network disasters

- Examples:
  - ✓ Heavy rain fall (high frequency) due to global warming (?) → disastrous floods (e.g., Seine river)
  - ✓ Earthquake (low frequency),e.g., submarine cables disruption between Europe and North of Africa in 2003
  - ✓ Hurricane, pandemic, attacks (cyber or physical), …
- *Geographic failures*: simultaneous outages of nodes/links in specific areas
  - ✓ Traditional local redundancy not applicable
  - ✓ Solution: geo-redundancy → tradeoff between costs and urgent/vital needs
- Correlated *cascading* failures due to disaster-based disruptions: interdependence between critical infrastructures (power grid, Internet, ..)
- Requirements: service continuity 'bypassed' by service availability
- On-going research, e.g., COST Action 15127 RECODIS ("Resilient communication services protecting end-user applications from disaster-based failures") – 2016/2020

Facing disasters (1/2)

- *Escalation* process: from the operations technician (incident) up to the CEO (crisis)
- Disaster recovery plan: different levels of crisis and different lists of people involved (information, attendance, decision making)
- Use of infrastructure redundancy, e.g., satellite phones, competitor's SIM cards
- Major event or crisis, e.g., power blackout: information sharing with the legacy electricity provider for resource optimization (limited lifetime of backup batteries)
- Use of mobile infrastructures and (owned or rented) backup power supply / air conditioning / pumps + (potential) help from the police for the transport
- Strategies according to the context, e.g., switching off low priority equipment to extend battery lifetime, fault isolation
- Launching the *business continuity plan*

Facing disasters (2/2)

- *Communication* center: facing medias, towards customers, …
  - ✓ Is it your fault ? If not, how do you know that it is not your fault ?
  - ✓ What are your current actions to face the situation ?
  - ✓ When have you learned about the situation ? What have you done since then ?
  - ✓ Is there any way to avoid this situation ?
  - ✓ Why didn’t your company avoid this situation ?
  - ✓ Etc.

NFV/SDN and disasters restoration

- Virtualisation technologies used on industry standard high volume servers/switches/storage
- Higher service availability provided to customers by agile network reconfiguration, e.g., moving from one Cloud to another
- Elasticity/scalability: capacity dedicated to NFs dynamically modified according to the load, e.g., gradual processing of the (increasing) traffic following the previous move (cf. availability enhancement with s/w update)
- Performance optimization: reconfiguration of network topology, e.g., resource minimization
- Use of predictions, e.g., precipitation, symptoms of earthquake, … to modify the topology/routing vs. facing the consequences in the PNF context
- Thorough analysis needed (after operational implementation)

Seine River Flood in 1910 (1/3)

Avenue Montaigne

Rue de la Seine

Seine River Flood in 1910 (2/3)

Boulevard Saint-Germain

Quai de Passy

Seine River Flood in 1910 (3/3)

Quai des Grands Augustins

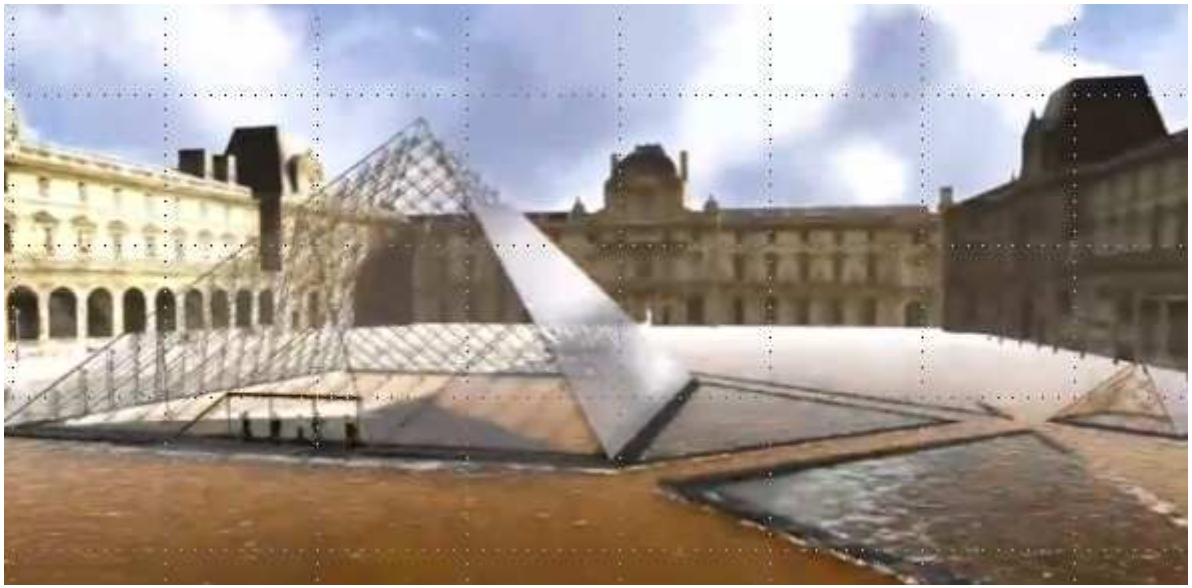
A Minister on the way to work

Simulation of the Century Flood (1/3)

- Impact: 830 K people with feet in the water, electricity outages for 5 M inhabitants (1.5 M without electricity), 30 billions € damage
- Crisis management and restoration of the situation (Sequana): March 7-18 2016 (flood peak: March 12-13, receding waters: March 15-18)
- Testing interdependencies and interactions between private and/or public partners
- Verifying the operations of european mutual assistance mechanisms (Belgium, Czech Republic, Italy, Spain)
- Information points:
  - ✓ Understand/anticipate the flood
  - ✓ Where to get supplies
  - ✓ Flood-risk areas
  - ✓ Evacuation procedures
  - ✓ Survive in degraded mode
  - ✓ Behavioral information
  - ✓ Return to normality, …

To probe further: www.prefecturedepolice.interieur.gouv.fr/Sequana

Simulation of the Century Flood (2/3)



Simulation of the Century Flood (3/3)

- Physical protection of the operator's premises (e.g., sandbags)
- Reinforcement of pools of technicians
- Antenna density in Paris allowing to maintain the outdoor coverage, e.g., SMS recommended for indoor communications
- Copper cables replaced by fibre network → better resilience
- Next (?) simulation: NFV/SDN inside ?
- Other crisis simulations: Hurricane, Tsunami (Caribbean Islands), …
- Target: design of backup sustainable architectures → Continuity as a Service