



### Newtork Models, Survivability quantification Stéphen Pirlot



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# TDF 1/2

### TDF group since 1975

TDF group is approx 3500 people (Europe)

### Business :

- TV and radio Broadcast
- Hosting Telecoms operators
- Smart services

### > In France :

- ▲ 9000 sites
- 800 routers / switchs
- ▲ 35 optical POPs, up to 350 Ethernet Service Access Points
- Up to 8 datacenters (in building)





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## TDF 2/2

### I work in Metz – TDF Pôle Réseau Télécoms

- A The actual MPLS network (TMS) was created by the experts in Metz
- This network is designed in services for each client
- Each service is created according to client demand

#### Protection needed to guarantee customers SLA

- Stable and efficient redundant topology (links, routers, ...)
- Design services to keep a good ratio cost/efficiency

#### Problem : How to choose between resilient solutions ?

- Standards indicators : Cost, Efficiency, Simple maintenance, Complexity, Number of simultaneous faults
- ▲ Use some diagrams to prove that the network is actually secured (and so there is no SPOF found)
- Specify an other indicator that include failures and a probabilistic view



## Goal : Survivability

DEFINITION 1. Survivability is a property of a system, subsystem, equipment, process, or procedure that provides a defined degree of assurance that the named entity will continue to function during and after a natural or man-made disturbance; e.g., nuclear burst. Note: For a given application, survivability must be qualified by specifying the range of conditions over which the entity will survive, the minimum acceptable level or post-disturbance functionality, and the maximum acceptable outage duration.

DEFINITION 2. Survivability is the ability of the network computing system to provide essential services in the presence of attacks and/or failures, and recover full service in a timely manner.

# Survivability quantification is an accurate indicator

Definition 3. A survivability specification is a four-tuple,  $(\{E,R,P,M\})$  where:

- E is a statement of the assumed operating environment for the system. It includes details of the various hazards to which the system might be exposed together with all of the external operating parameters. To the extent possible, it must include any anticipated changes that might occur in the environment.
- R is a set of specifications each of which is a complete statement of a tolerable form of service that the system must provide. This set will include one distinguished element that is the normal or preferred specification, i.e., the specification that provides the greatest value to the user and with which the system is expected to comply most of the time.
- P is a probability mass function across the set of specifications, R. A probability is associated with each member of the set R with the sum of these probabilities being one. The probability associated with the preferred specification defines the fraction of operating time during which the preferred specification must be operational.
- *M* is a finite-state machine denoted by the four-tuple {*S*, *s*<sub>0</sub>, *V*, *T*} with the following meanings:
  - S: A finite set of states each of which has a unique label which is one of the specifications defined in R.
  - $-s_0$ :  $s_0 \in S$  is the initial or preferred state for the machine.
  - V: A finite set of customer values.
  - T: A state transition matrix.

and a system is survivable if it complies with its survivability specification



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## My idea : Using Bayesia Models 1/2

### Quantifying Survivability is possible

- Using algorithms to calculate complex systems
- Using network models to dynamically test some issues
- It permits to quantify the level of resilience of a solution

### Bayesia Models

- Can include Fault Tree Analysis
- Are stables models
- Used to model complex systems like nuclear power plants
- Can model survivability

### Bayesia Labs

- Modeling our network failures
- Simplify choices to secure the network







## My idea : Using Bayesia Models 2/2





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### Discussions

### > More

- Limitations of BayesiaLab
- Test other software about network models
- Define some strategies about choices to secure services

### Discussions

- Modeling Bayesian Networks
- Using BayesiaLab









# Thanks for your attention

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