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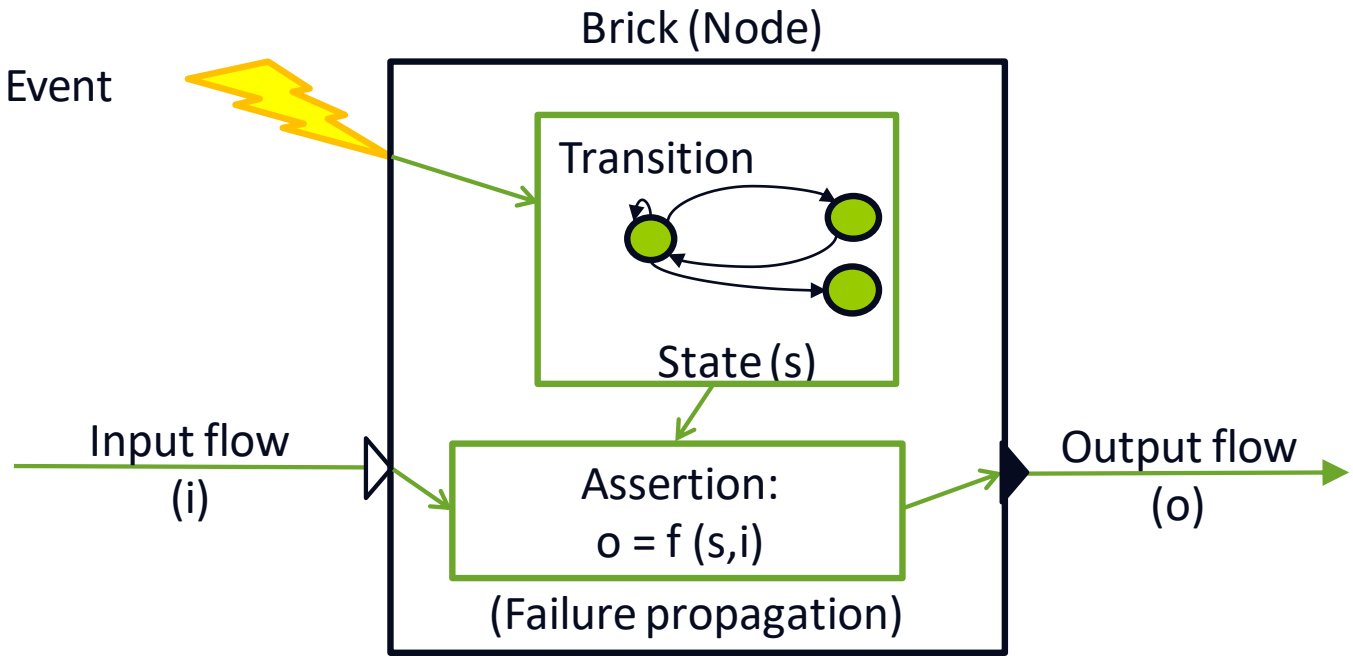
SimfiaNeo

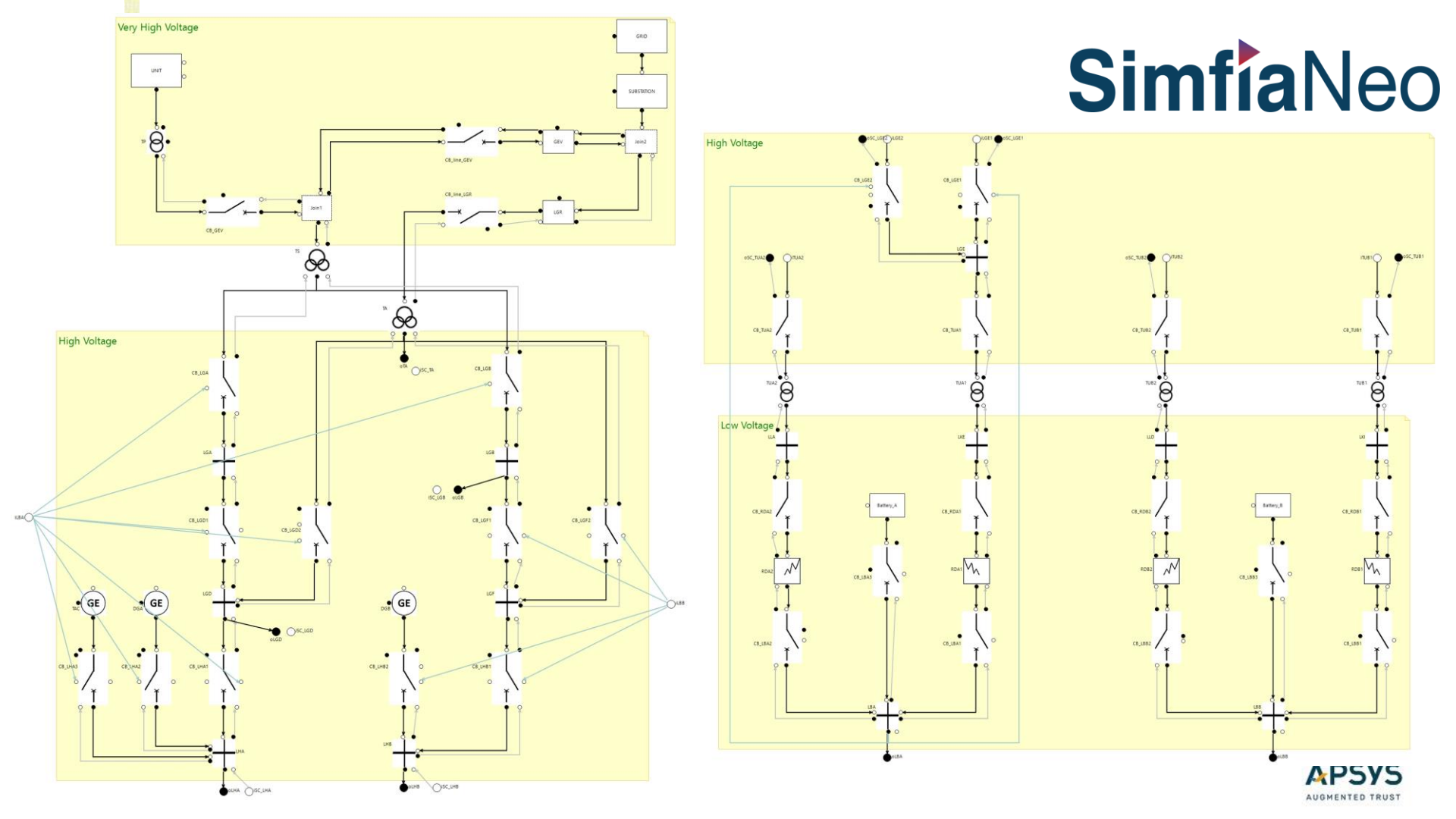
Workshop
Electrical benchmark

14th June 2019, Saclay

Methodology

AltaRica Model – Node





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Metrics

- Number of classes: 16
  - GE, Bus bar, Circuit breaker, …
- Number of instances: 75
- Number of specific bricks: 17
  - Control-Command, GRID, …

92 bricks

Metrics

- Number of state variables: 134
- Number of events: 310
- Number of links: 314
- Number of (generated) AltaRica lines: 4300

Computations

- Quantitative
  - Monte-Carlo simulations

- Qualitative/Quantitative
  - Stochastic generation of sequences

Model

Circuit breaker

4 main types of circuit breakers

- Simple
  - CB_TUAx, CB_TUBx, CB_RDAx, CB_RDBx
- Powered
  - CB_LGA, CB_LGB
- Controlled
  - CB_LBAx, CB_LBBx, CB_GEV, CB_line_xxx
- Powered and Controlled
  - CB_LGDx, CB_LGFx, CB_LHAx, CB_LHBx, CB_LGEx

Circuit breaker (Simple)

- 4 connectors
  - upStream, downStream
  - iSC, oSC
- 3 state variables
  - isStuck, isOpen
  - state1 *{nominal, failed}*
- 6 events
  - open, refuseToOpen
  - close, refuseToClose
  - shortCircuitFailure
  - repair

45 generated lines

Transformer

- 4 connectors
  - upStream, downStream
  - iSC, oSC
- 1 state variable
  - state1 *{nominal, shortCircuit, failed}*
- 3 events
  - shortCircuitFailure
  - burnFromExternalShortCircuit
  - repair

31 generated lines

Short-circuits are not propagated

Exposure to an external short-circuit burns the transformer (0.1 h)

Reconfigurations

- Three levels of command for circuit-breakers, GE, …
  - Itself:
    - *incoming short-circuit => try to open*
    - *no incoming short-circuit => try to close*
  - Local (with delays):
    - *switch between branches*
    - *GE and battery are avoided whenever possible*
  - Global priorities (with delays):
    - *GRID-UNIT*
    - *Batteries*
    - *LGA-LGB*
    - *LHA-LHB*

Interdependencies

- Connections between High voltage and Low voltage
  - High <-> Low: LHA and LHB
  - High -> Low: TA, LGD and LGB

- Power supply of circuit breakers
  - LBA and LBB

Simplifying assumptions

- Not all short-circuits propagation from Low voltage to High voltage
- No failure on sollicitation when solliciting both GE at the same time (but still individual failures on sollicitation)

Validation

- Step-by-step simulation to check scenarios
  - Short-circuit propagation
  - Reconfigurations
  - …

Results

Results – Monte-Carlo simulation

- 10,000 hours, 1,000,000 simulations, i5cpu@2.6GHz
  - 20 minutes computation
  - Unreliability: 3.9E-5 ±1.2E-5
  - Unavailability: 1.4E-7 ±0.7E-7

Results – Stochastic generation

- 30 max probability events, 1,000,000 simulations, i5cpu@2.6GHz
  - 10 minutes computation
  - 700 different sequences
    - *very few identical*
    - *most probable ”macro-sequence” is*
      - GRID failure
      - UNIT good switch to House load
      - UNIT House load failure
      - CB_LBx3 refuse to close

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