

# GSPNs and CTMCs

## dual view

- time discrete: stochastic
- time continuous: deterministic
- linked via exp distribution
- two state A->B example

## Measures for GSPNs

- P(transition active)
- transition throughput
- Avg #Tokens in place
- P(Place is empty)
- Queuing example

## Generalized Stochastic Petri Nets

- removing vanishing states --> CTMC
- for exp: rate \* probability = new rate
- tangible state vs. vanishing state
- queue-2 server example
- extends SPN by immediate transitions
- 1984: Marsan, Balbo, Conte

## History

- 1960er - Carl Adam Petri: S/T-Nets
- contain only places, transitions, arcs and tokens
- 1980/81 Molloy: Stochastic Petri Nets
- contain timed transitions with exponential distributions
- every SPN describes a CTMC!
- no multiplicities, guard functions inhibitors...

## State Space

- marking - number of tokens in every place of the SPN
- state space = set of all reachable markings
- dependent on the initial marking
- example: 2 places / 2 transitions - size  $n+1$
- example: 3 places / 4 transitions. - size  $\sim (n+1)^{2/2}$
- polynomial growth of size of state space

## Reachability Graph

- state space plus state transitions
- can depend on initial marking
- arcs = SPN transitions
- if real SPN --> RG=CTMC
- SPN is more compact than CTMC
- SPNs widely used, since CTMCs are easy to solve