Predicting Specification Violations During BGP Convergence

Roland Schmid, Tibor Schneider,
Georgia Fragkouli, Laurent Vanbever

CoNEXT Student Workshop 2023
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Networked Systems
ETH Zürich — seit 2015

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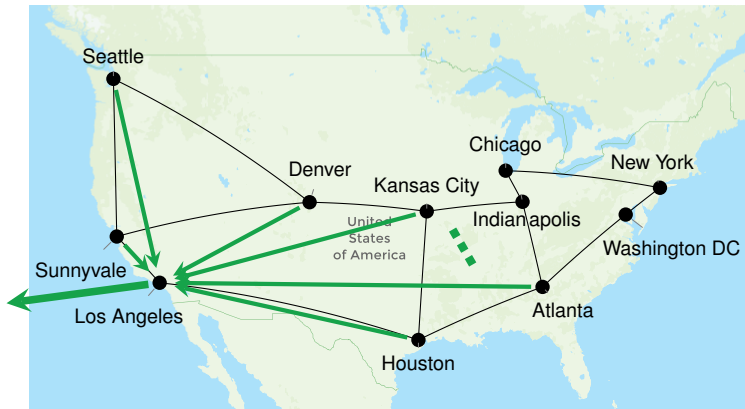
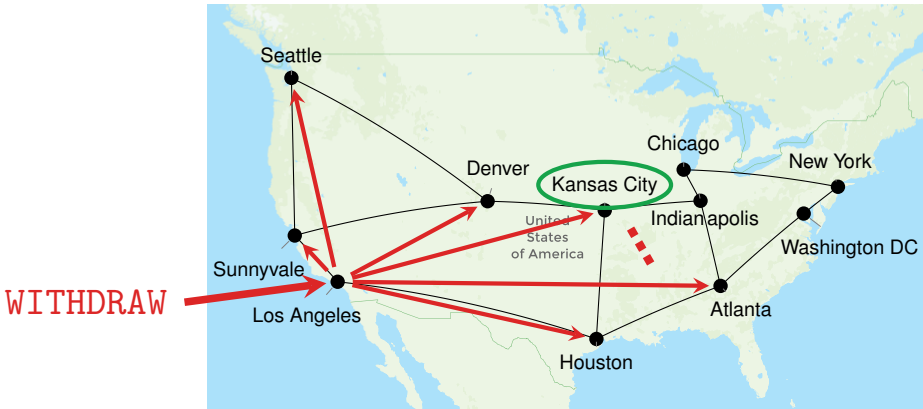
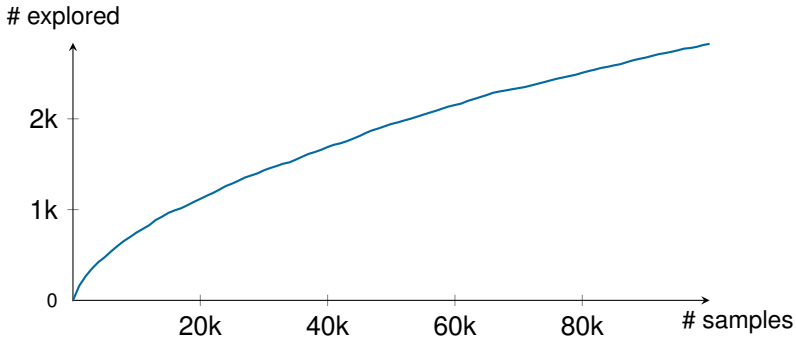


How does a network forward traffic **during** BGP convergence?



How does a network forward traffic **during** BGP convergence?

The traffic flow **depends on the timings** of the forwarding updates.



Approach: estimate the **timely duration** of specification violations.

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verification $\iff$ Which specification is violated?

$\rightarrow$ *Can all routers reach* `100.0.0.0/24`*?*

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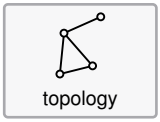
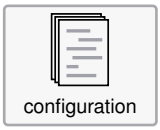
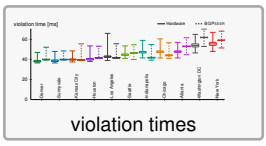
transient violation time: predicted specification violation & its duration


topology


configuration


event


specification


violation time [ms]
Hardware
BGPsim
60
40
20
0
Denver
Kansas City
Houston
Los Angeles
Seattle
Indianapolis
Chicago
Atlanta
Washington DC
New York
violation times

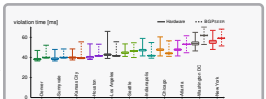
topology

configuration

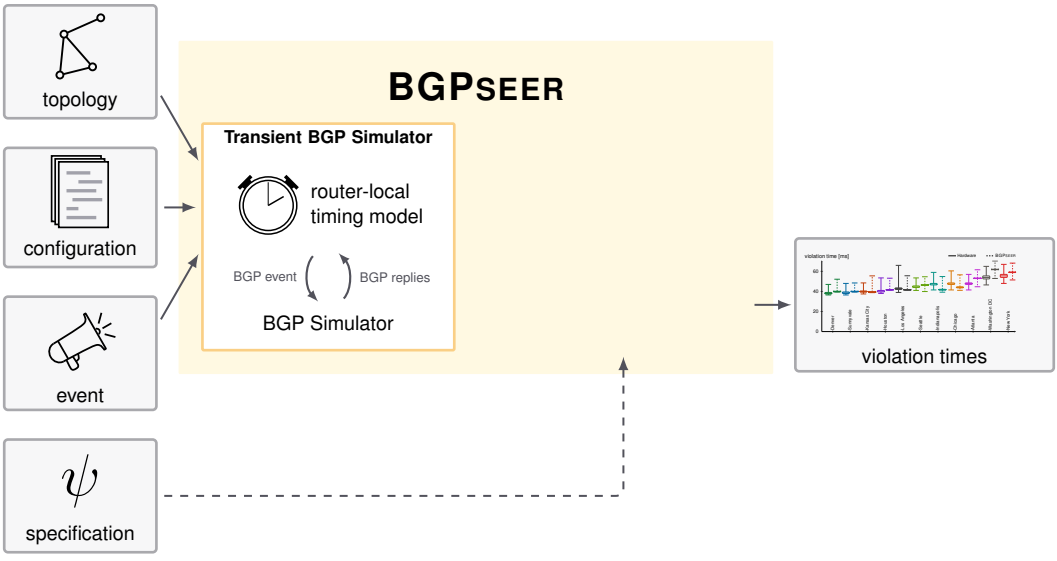
event

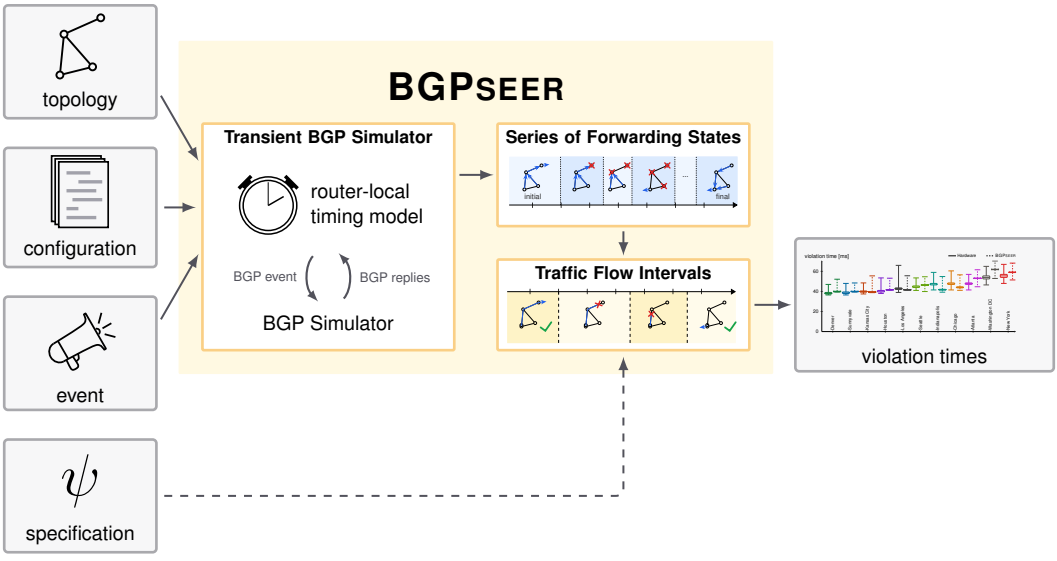
specification

BGPSEER



violation times


topology
configuration
event
specification
BGPSEER
Transient BGP Simulator
router-local
timing model
BGP event
BGP replies
BGP Simulator
violation times


topology
configuration
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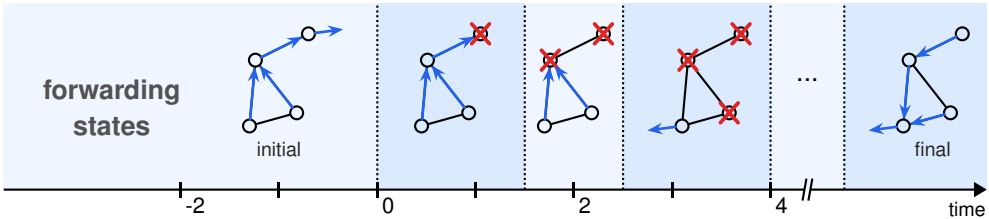
BGPSEER
Transient BGP Simulator
router-local
timing model
BGP event
BGP replies
BGP Simulator
Series of Forwarding States
initial
final
Traffic Flow Intervals
violation times

BGPSEER computes a **time series** of forwarding states.



Assuming: propagation delay ≙ 1 time unit, processing time ≙ 0.5 time units.

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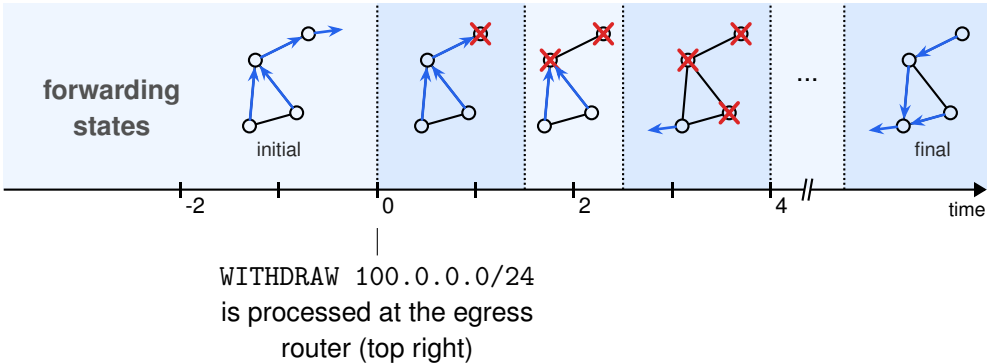

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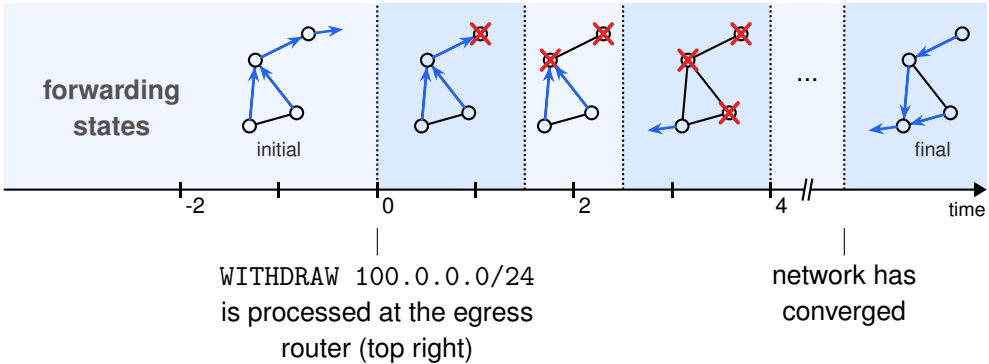

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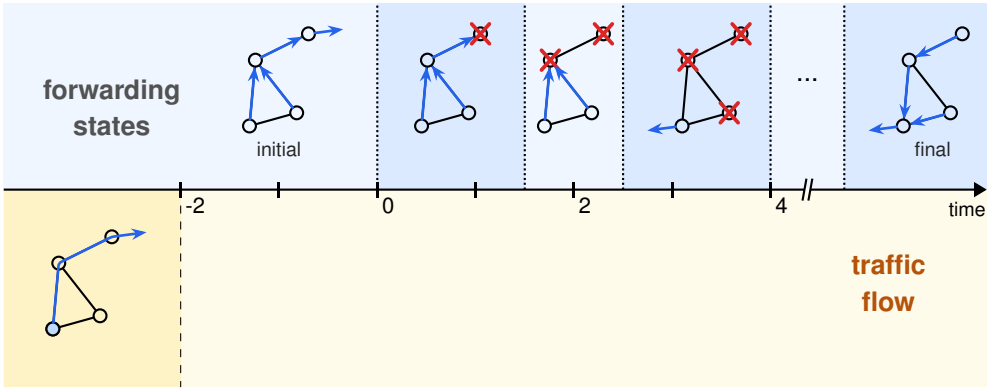

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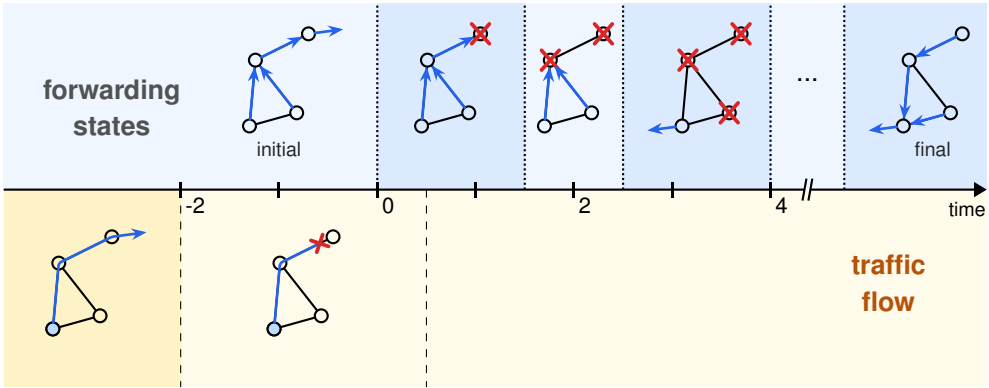

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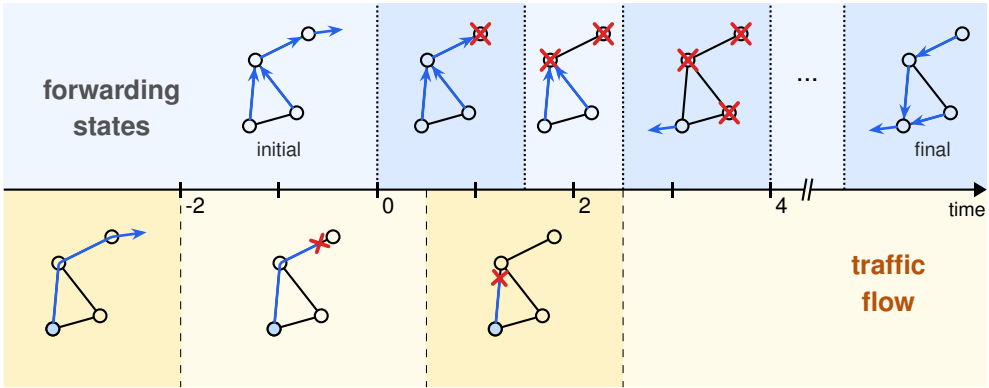
Using the sampled times, BGPSEER infers **traffic flow intervals**.



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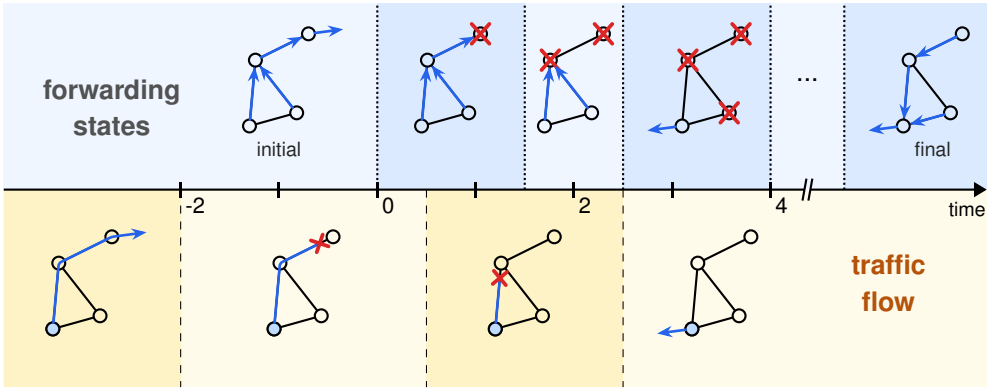

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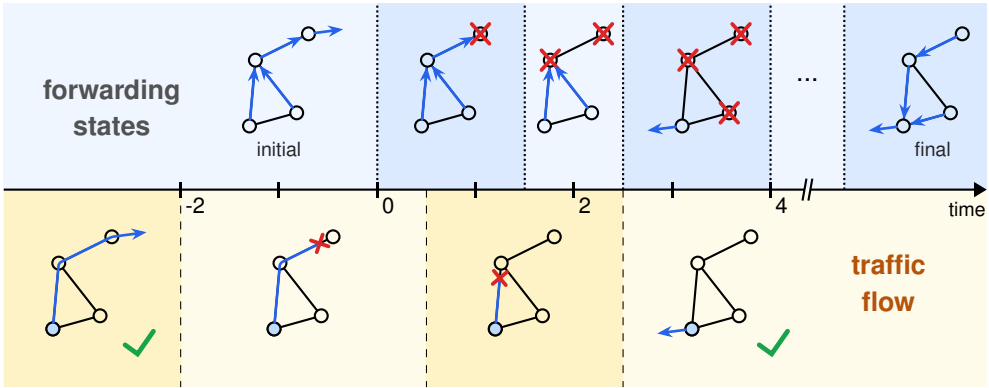

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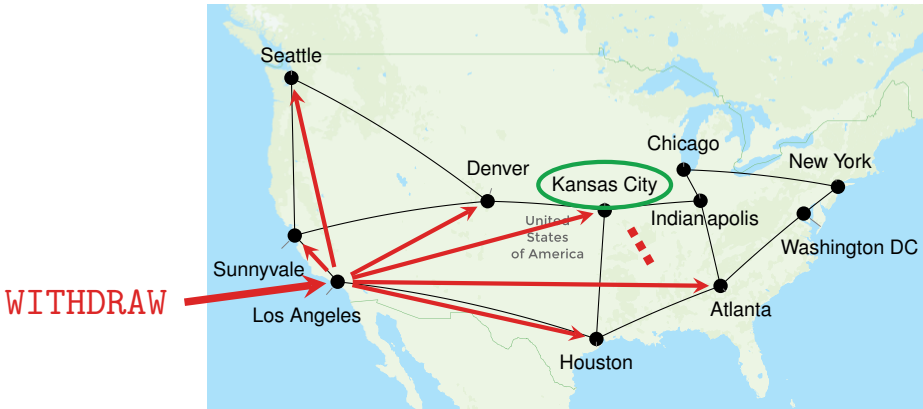

violation time [ms]
0
20
40
60
Denver
Sunnyvale
Kansas City
Houston
Los Angeles
Seattle
Indianapolis
Chicago
Atlanta
Washington DC
New York

violation time [ms]
Hardware
BGPSEER
60
40
20
0
Denver
Sunnyvale
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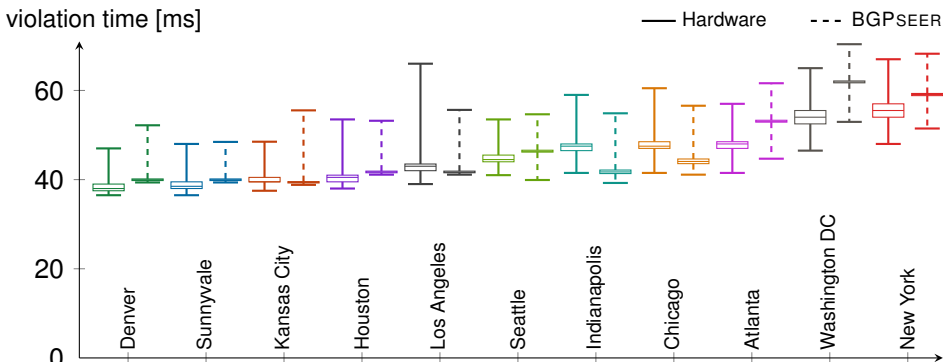
violation time [ms]
Hardware
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60
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Atlanta
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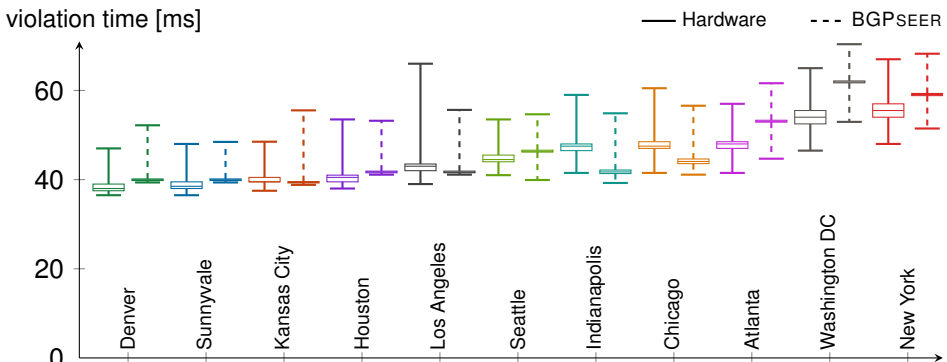
BGPSEER estimates the violation times with **85%-99%** accuracy.



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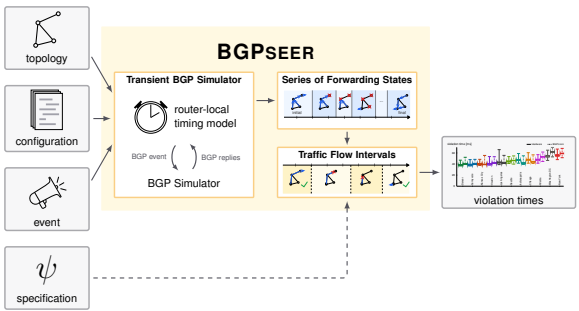

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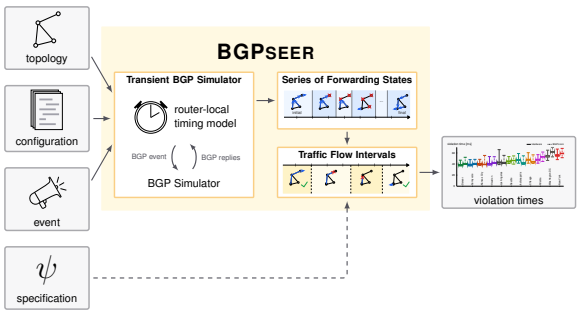

We present an approach to:

- **simulate transient** network behavior,
- infer transient traffic flow, and thus
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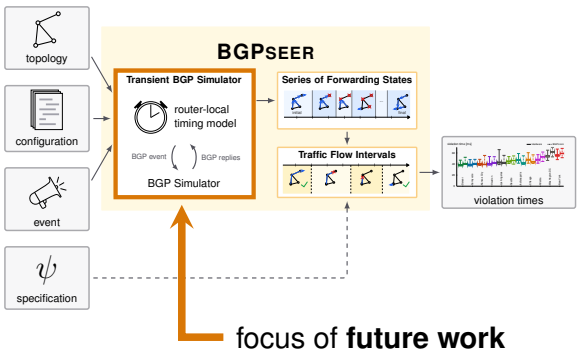

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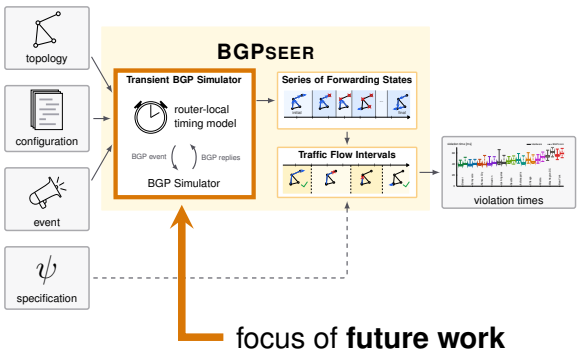

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