



# *Survey and Characterization of the Internet Quality of Service*

## *Cause-Effect in BGP Behavior*

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# QoS Parameters

- Additive and non-additive
  - Temporal Parameters:
    - Delay
    - Jitter
    - Packet Loss
    - Bandwidth
  - Elastic and non-elastic applications
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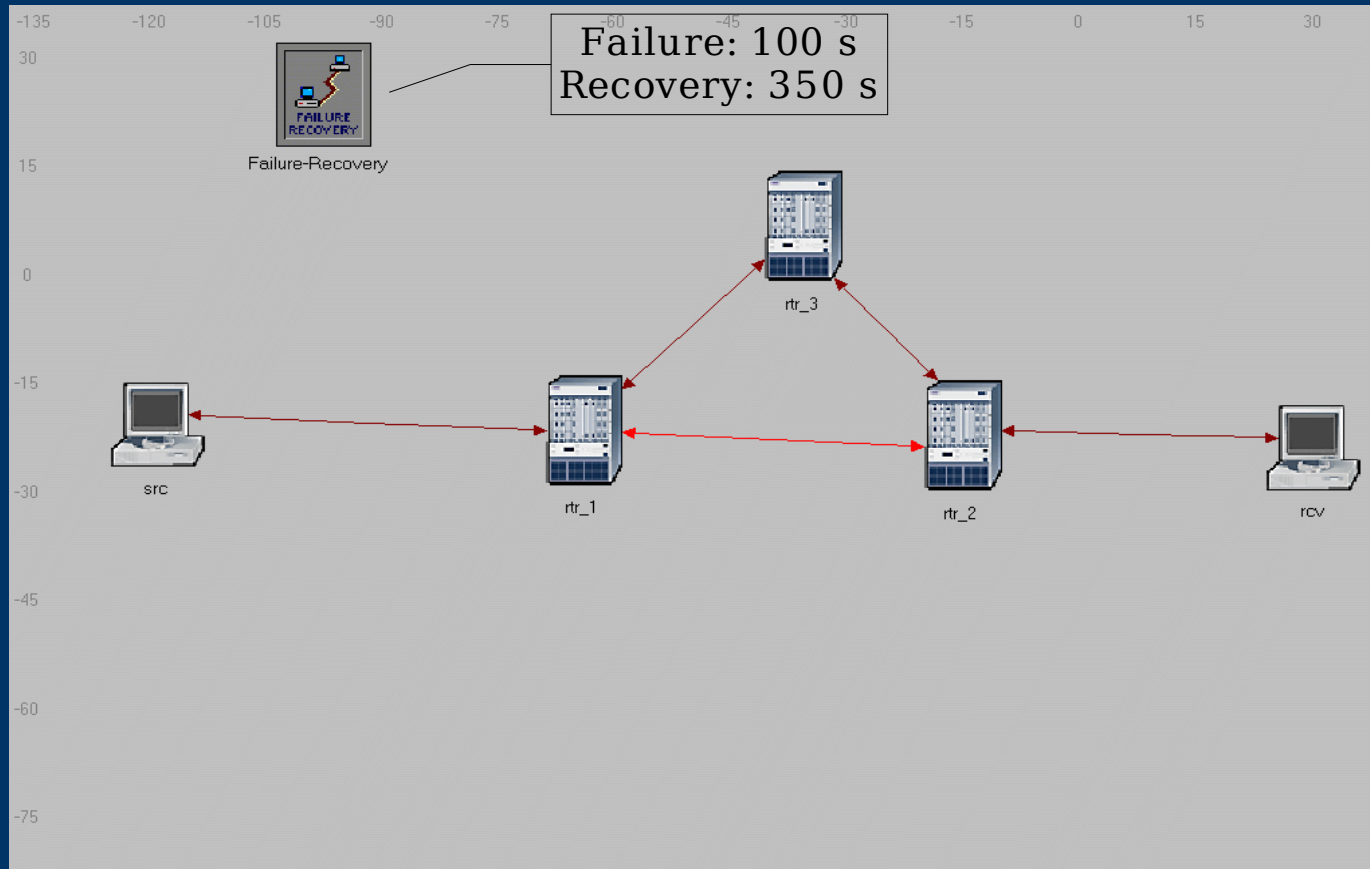
# *Patterns and Outliers*

- Extreme Value – called outliers, sudden unexpected values;
  - Plain – same or similar QoS values ranging within a given interval;
  - Increase/Decrease – increasing or decreasing values of the QoS parameters;
  - Composite – complex patterns defined by sequences of basic pattern types.
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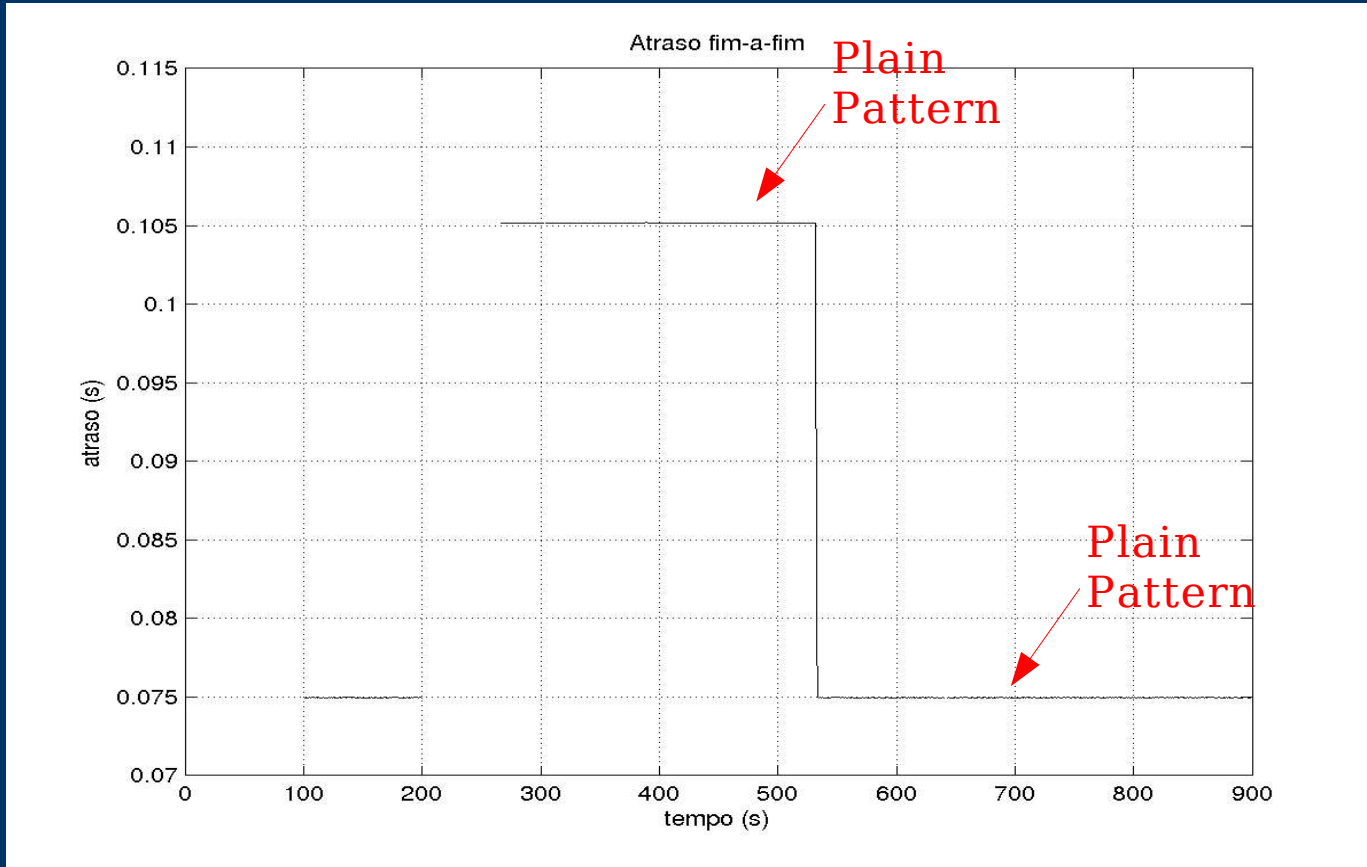
# *Causes of BGP Instability*

- Routing Instability
    - Router vendor's implementation decision
    - Misconfigured BGP/IGP protocol or their interaction
    - Software bugs or flaws in routers
    - Timer problem
  - Slow Convergence
    - Delay stemmed from queuing and router CPU processing
    - Unexpected interaction (timers and decision process)
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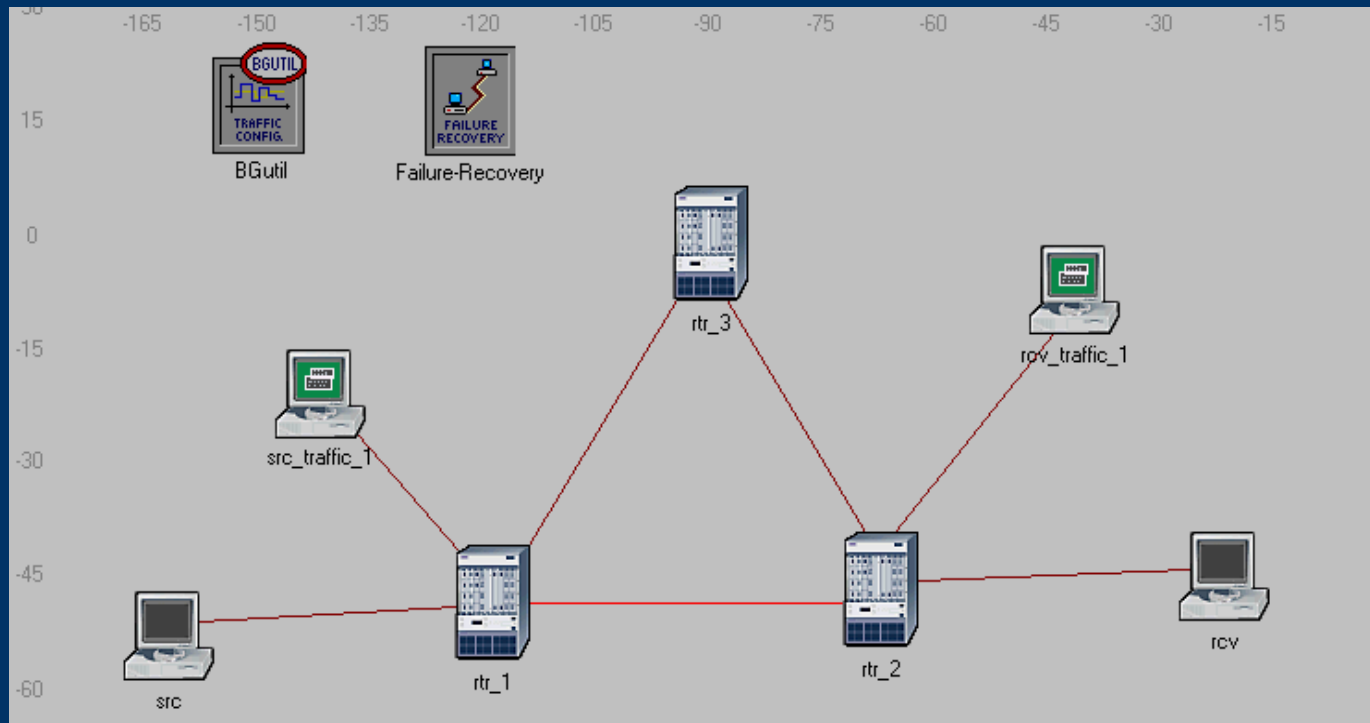
# Scenario 1



# Delay – Scenario 1



# Scenario 2

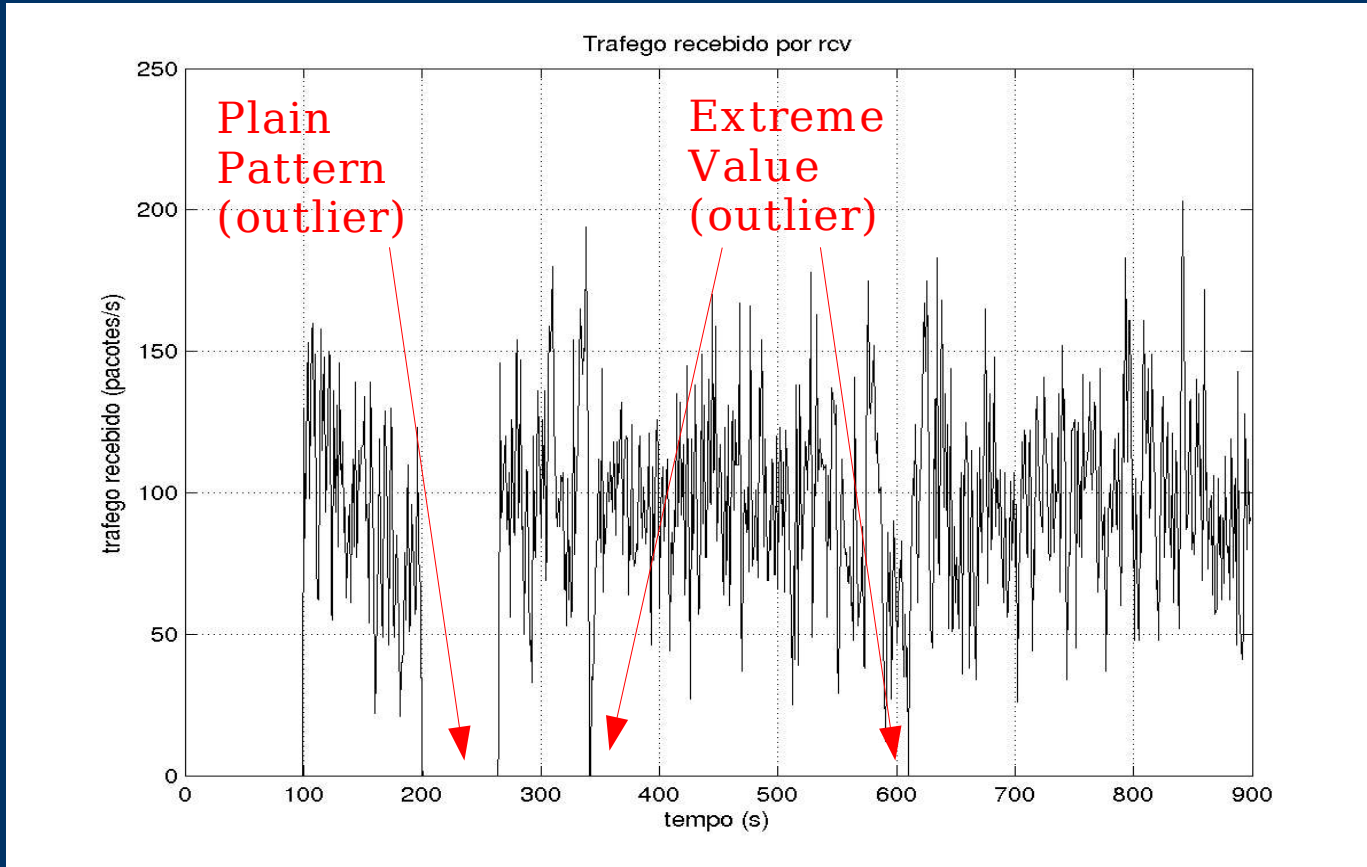


# *Configuration*

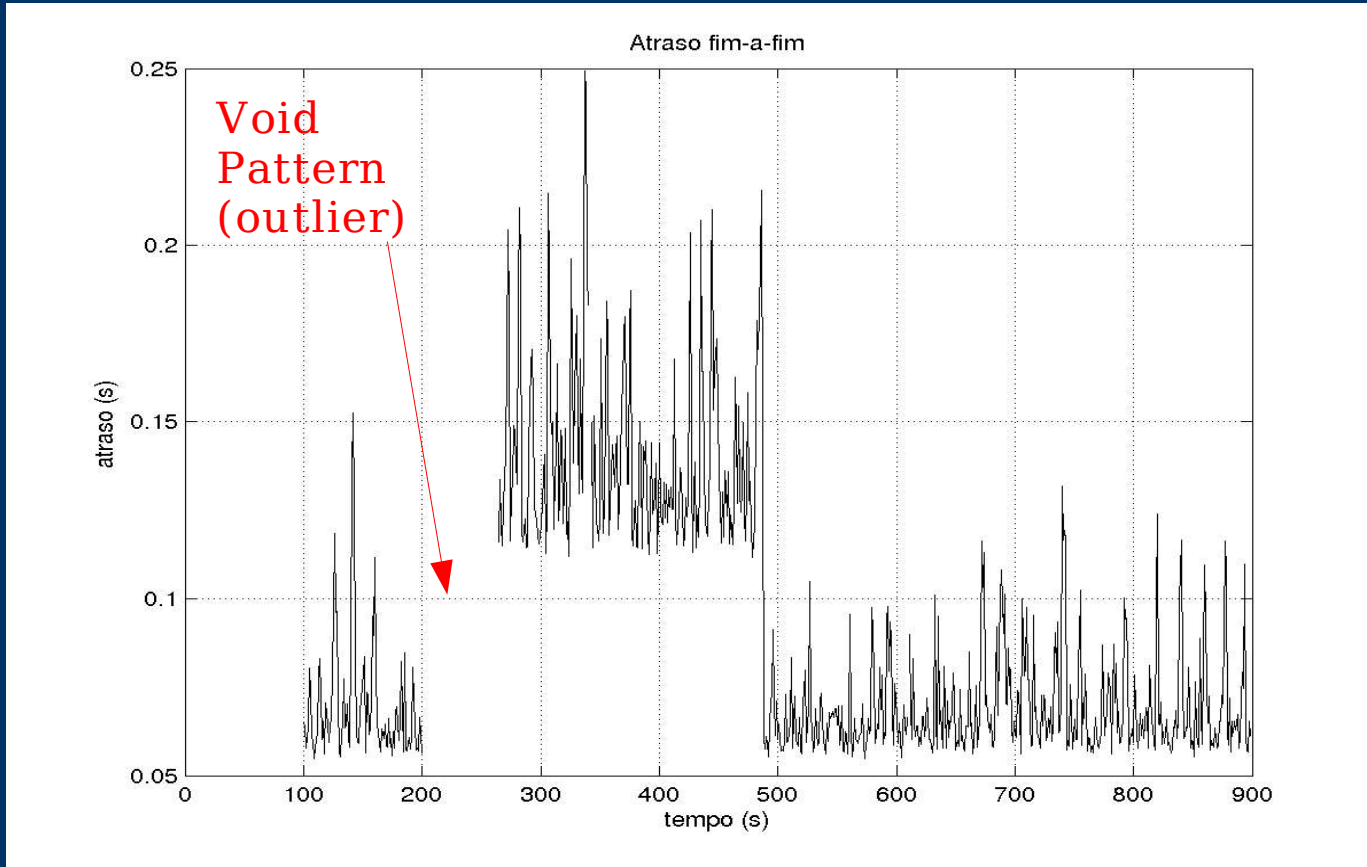
- Failure-Recovery
  - Failure at 200 s
  - Recovery at 350 s
- Background Traffic
  - Near 98% of the links capacity



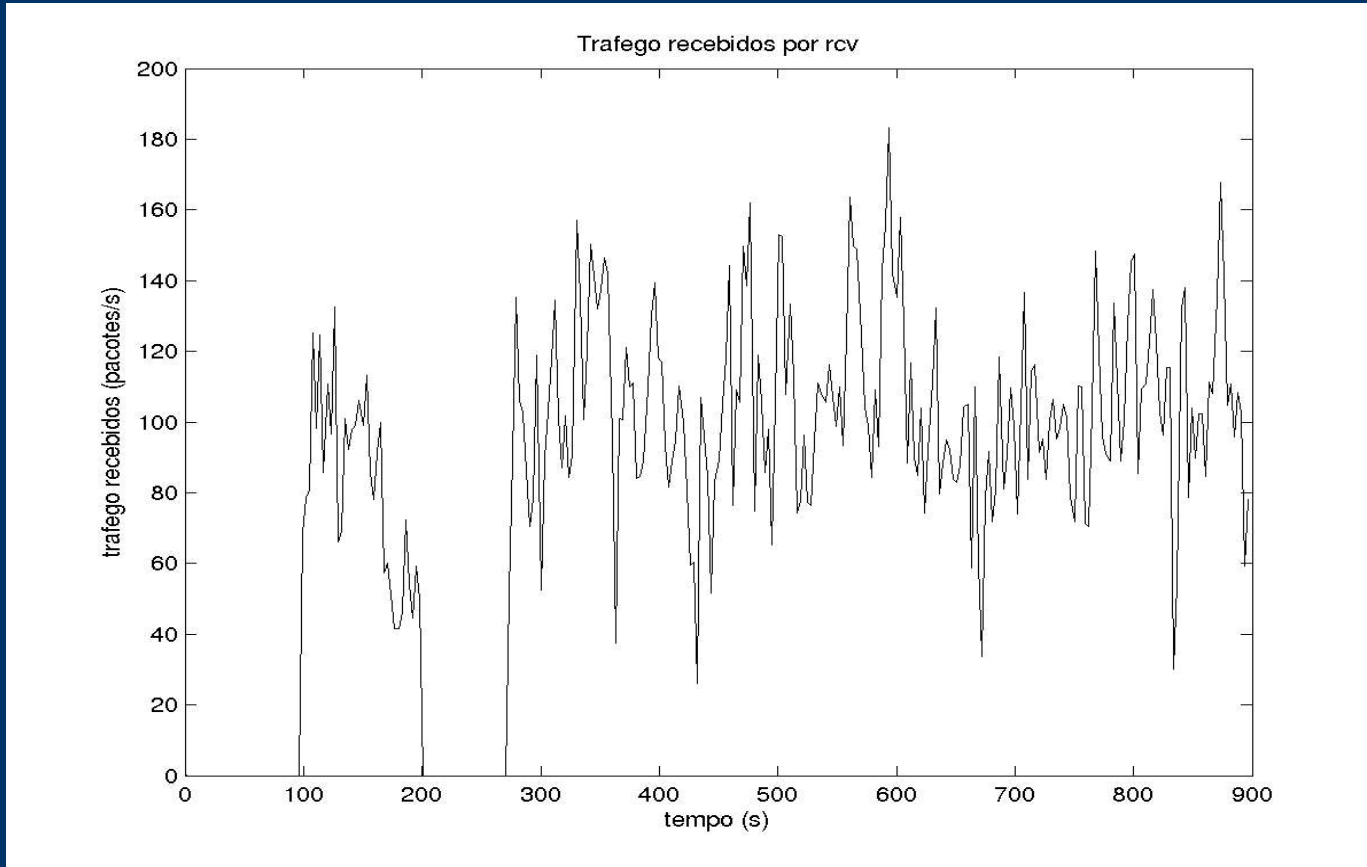
# Received Traffic – Scenario 2



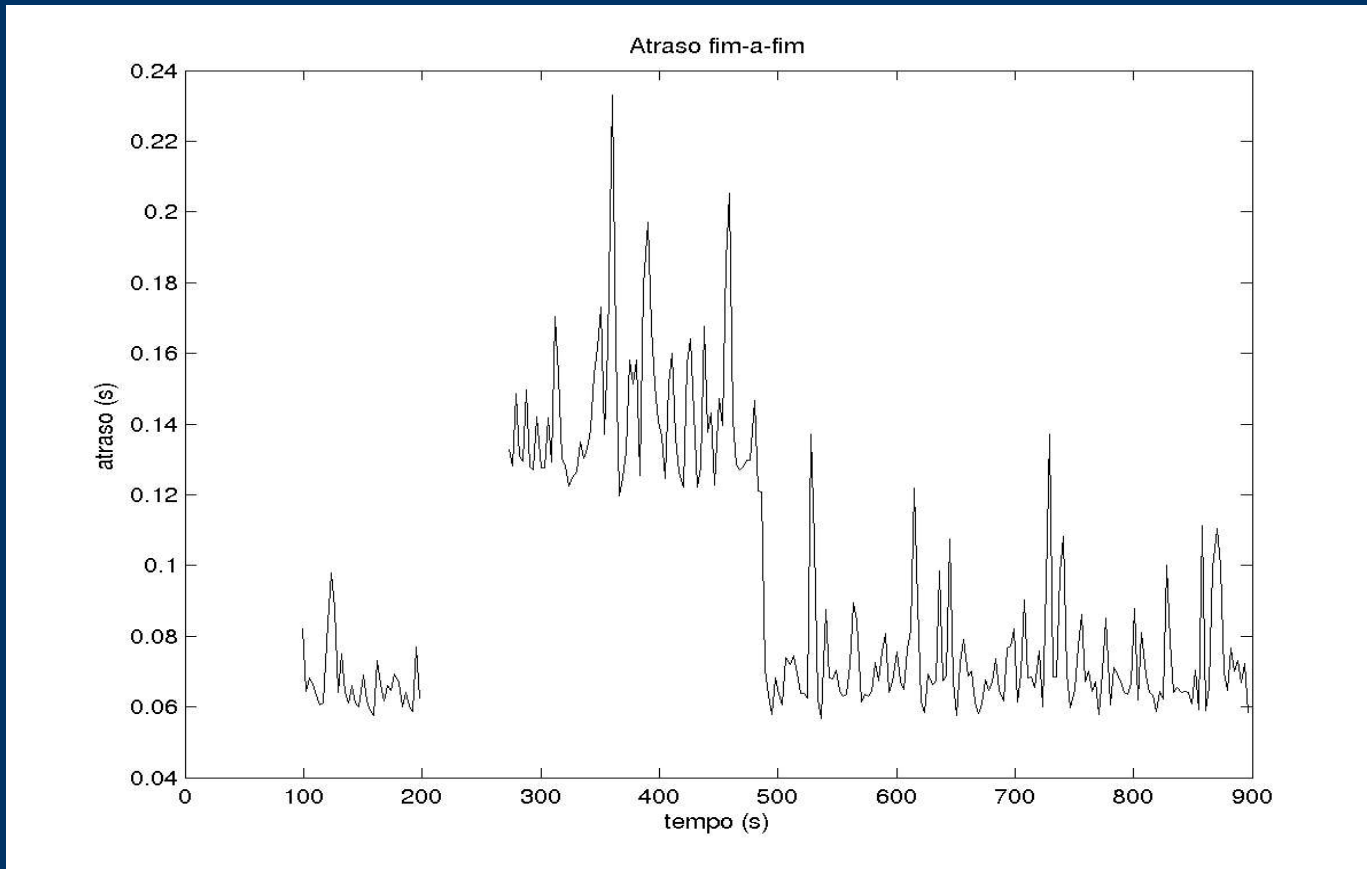
# Delay – Scenario 2



# Received Traffic – 3 seconds



# *Delay – 3 seconds*



# *Cause-Effect Relationship*

- Cause:
    - Link fault and BGP convergence
  - Effect:
    - Delay – pattern void and after new level of average delay
    - Received Packets – pattern plain in zero
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