NOTES ON IS-IS NETWORK CONVERGENCE

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NETWORK CONVERGENCE

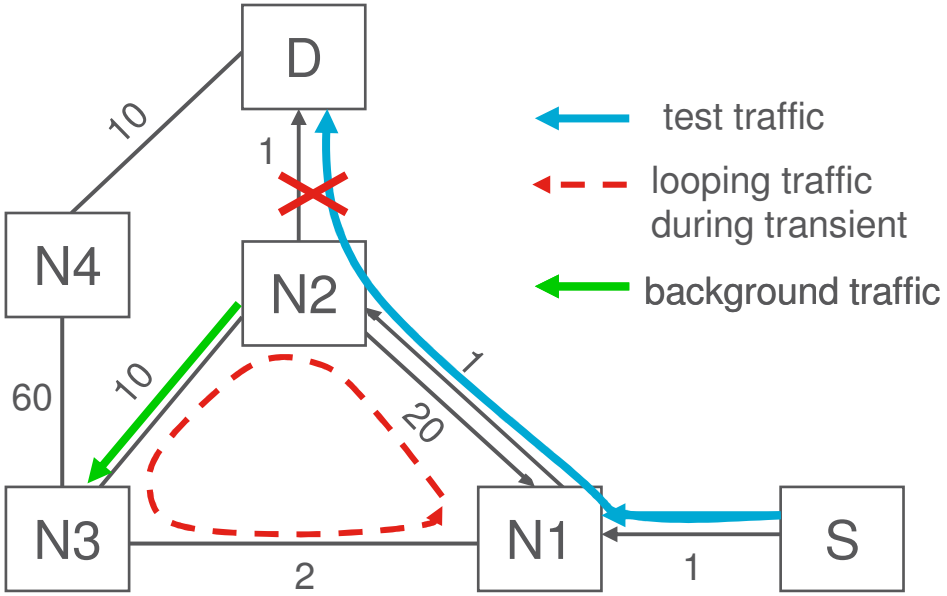
- Convergence Time
  - The time elapsed from a topology change realized by the control protocol until the forwarding has been recovered
- Goal
  - Investigate the effect of loop prevention on network convergence
- Loop prevention implemented
  - Neighbor synchronization as described in http://www.ieee802.org/1/files/public/docs2008/aq-farkas-link-state-handshake-0308.pdf
    - Mismatching topology view → Neighbors do not exchange data packets
    - (Brute force version of the Agreement Protocol)
  - Topology Digest as described in http://www.ieee802.org/1/files/public/docs2008/aq-fedyk-ISIS-digest-1108-v1.pdf
  - 3-way handshake using IS-IS Hello PDUs

MEASUREMENT SET-UP

- Quagga IS-IS
- IS-IS controls an IP network

Parameter	Value
helloInterval	1s
holdingTime	2s
maxAge	1.2s
minLSPGenerationInterval	1s
maxLSPGenerationInterval	900s
minLSPTransmissionInterval	1s
minSPFInterval (spfDelay)	1s

- Test network



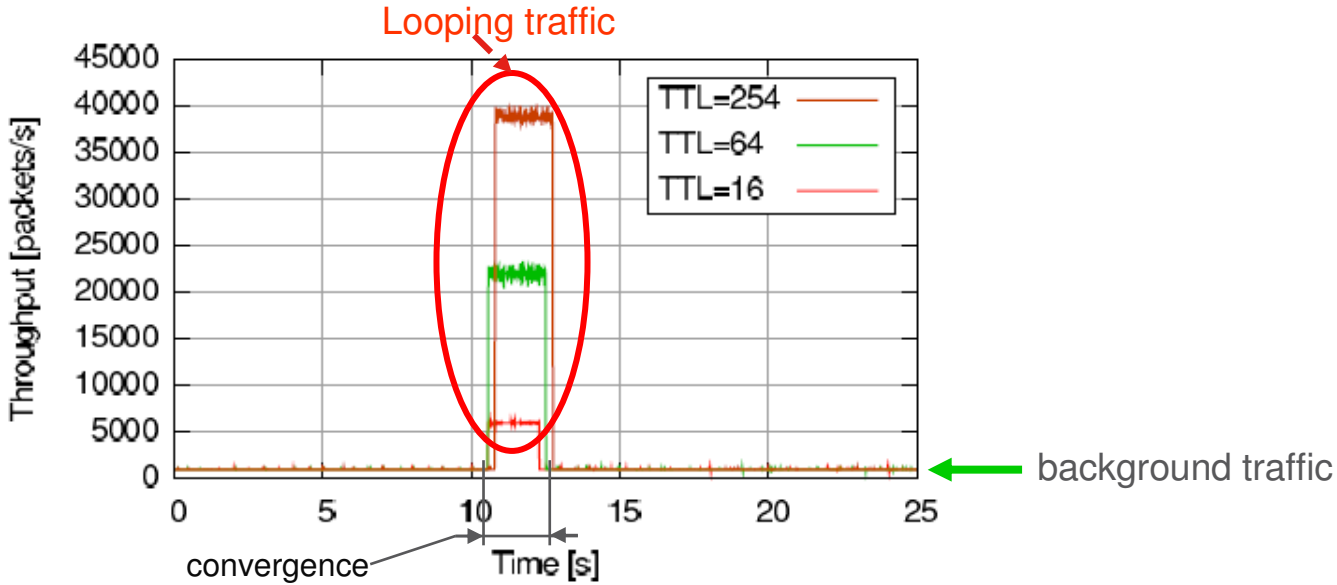
- Note – this scenario cannot appear in SPB because ISIS-SPB enforces symmetric link metric

MEASUREMENT RESULTS

- Convergence time = the time elapsed from a failure event realized by the control protocol until the forwarding has been recovered
- Neighbor Synchronization did not increase the convergence time [s]

[s]	No loop prevention			Neighbor synch
	TTL=16	TTL=64	TTL=254	
min	1.58	1.41	1.48	1.61
avg	**1.97**	**2.07**	**2.06**	**2.10**
max	2.50	2.40	2.49	2.56

- Not having loop prevention causes overload, e.g. on N2-N3 link



SIMULATION SET-UP

- C++ simulator
- IS-IS is implemented as a Higher Layer Entity in 802.1Q
  - IS-IS is accelerated with fined tuned parameters in order to capture the effect
    - minLSPTransmissionInterval = 0
    - spfDelay = 0

Parameter	Value
helloInterval	1s
holdingTime	2s
maxAge	1.2s
minLSPGenerationInterval	1s
maxLSPGenerationInterval	900s
minLSPTransmissionInterval	0s
spfDelay	0s

- Investigated topologies
  - AT&T [2]
  - Germany50 [2]
  - COST266 [3]
  - Random (Waxman) [4]
    - 100-node
    - 150-node

- Evaluated scenarios
  - Single link failure
  - Single node failure

COST266

SIMULATION RESULTS

Convergence Time [ms]

- Single link failure

	AT&T	Germany50	Cost266	R100	R150
Default IS-IS					
min	2667	4941	5305	3898	4921
avg	**3641**	**5472**	**5767**	**4593**	**5499**
max	4281	5899	6050	5321	6092
Fine tuned IS-IS, no loop prevenciotn					
min	7.38	34.66	17.98	162.69	394.08
avg	**7.98**	**35.43**	**18.63**	**163.65**	**394.81**
max	8.39	35.67	19.10	164.09	395.74
Fine tuned IS-IS with neighbour synchronization					
min	8.38	35.50	18.99	164.09	395.09
avg	**9.01**	**36.02**	**19.62**	**164.73**	**395.76**
max	9.44	36.67	20.11	165.10	396.75

- Single node failure

	AT&T	Germany50	Cost266	R100	R150
Default IS-IS					
min	3890	6356	6217	4864	6146
avg	**5168**	**7294**	**6975**	**5645**	**6518**
max	6032	8705	8184	6311	7441
Fine tuned IS-IS, no loop prevenciotn					
min	8.44	37.10	19.21	164.09	394.73
avg	**9.34**	**37.63**	**21.04**	**164.49**	**395.14**
max	10.33	38.34	26.14	165.09	395.74
Fine tuned IS-IS with neighbour synchronization					
min	8.44	37.68	22.00	164.69	395.74
avg	**10.20**	**44.81**	**29.32**	**165.33**	**396.75**
max	11.40	50.79	43.17	166.09	397.75

SUMMARY

- Loop prevention does not significantly increase network convergence time
- No change can be perceived with default IS-IS parameters
- Slight increase in convergence time in case of accelerated IS-IS for up to 150-node networks
  - Less than 2 ms in case of link failure
  - Around at most 10 ms in case of node failure

REFERENCES

Further simulation details

[1] J. Farkas and Z. Arato, "Performance Analysis of Shortest Path Bridging Control Protocols," IEEE GobeCom 2009, Honolulu, December 2009. http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=5425776
(and further references therein)

Simulation topologies

[2] Survivable fixed telecommunication Network Design library (SNDlib) http://sndlib.zib.de

Germany50:
http://sndlib.zib.de/resource.get.action?objectName=germany50&resource=image&fileName=germany50.jpg&objectType=networkCOST266
COST266:
http://sndlib.zib.de/resource.get.action?objectName=cost266&resource=image&fileName=cost266.jpg&objectType=network

[3] M. L. Garcia-Osma. TID scenarios for Advanced Resilience. Tech. Rep., The NOBEL Project, Work Package 2, Activity A.2.1, Advanced Resilience Study Group, Sep 2005.

Random

[4] A. Medina and A. Lakhina and I. Matta and J. Byers. BRITE: Boston university Representative Internet Topology gEnerator, 2005. http://www.cs.bu.edu/brite