



Congestion Control in Recursive Network Architectures

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Pristine



UiO • University of Oslo

Pristine: Who we are and what we're doing



ict-pristine.eu

Atos



CREATE-NET

ERICSSON

i2cat

iMinds
CONNECT INNOVATE CREATE

nexedi



PREDICTABLE
NETWORK
SOLUTIONS

THALES

Telefónica I+D
Leading the innovation
of Telefónica

TELECOM
SudParis

TSSG



The Internet and Recursive Architectures



Internet

Application	
TCP/UDP	
IP	
Link	LLC
	MAC
Physical	

- QoS, MPLS, etc
- Proxies, middle boxes, etc

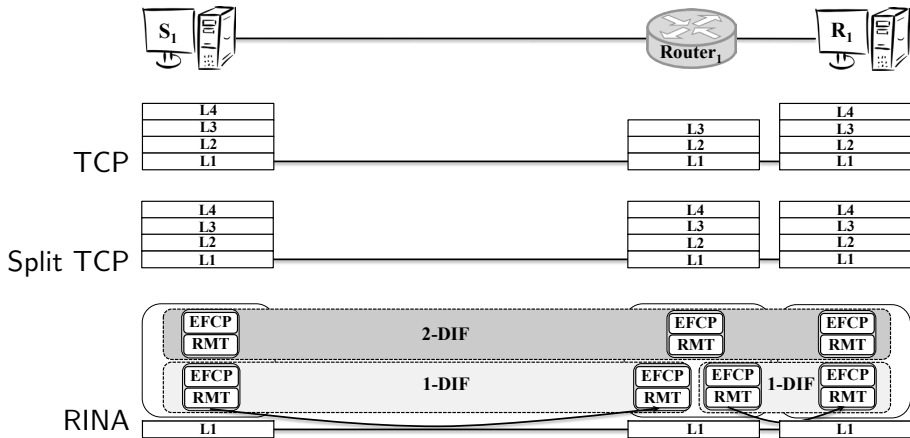
Recursive Architecture

Application
Generic Layer
...
Generic Layer
Physical

Examples include:

- Recursive Inter-Network Architecture (RINA)
<http://www.pouzinsociety.org/>
- Recursive Network Architecture (RNA)
<http://www.isi.edu/rna/>

Comparative RINA Example



From P. Teymoori, M. Welzl, G. Stein, E. Grasa, R. Riggio, K. Rausch, and D. Siracuss. [Congestion control in the recursive internetwork architecture \(RINA\)](#). In *IEEE International Conference on Communications (ICC), Next Generation Networking and Internet Symposium*, May 2016.

to appear

Congestion Control



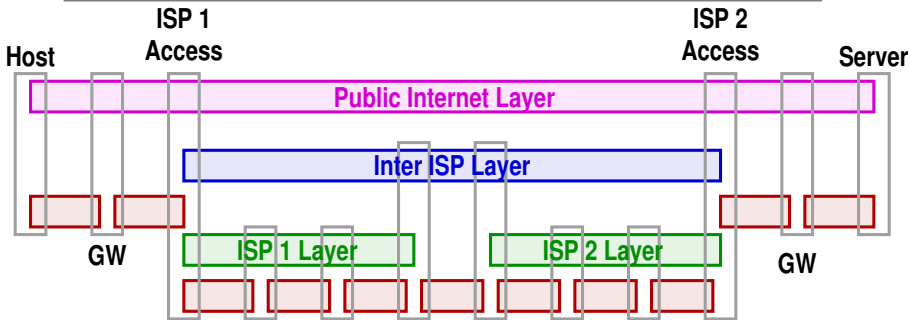
Types of “solvable” Network Congestion

- Network adaption – traffic rerouted along less congested paths
- Network restriction – admission control and policing
- End system adaption – traffic *sources* adjust send rates

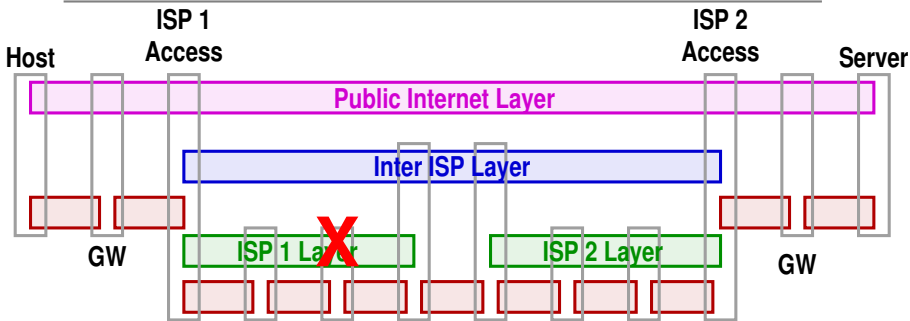
Recursive CC work in RINA

- Stability of chained and stacked congestion controllers
- Congestion signals and how they influence performance
- Stable scalable new types of congestion control

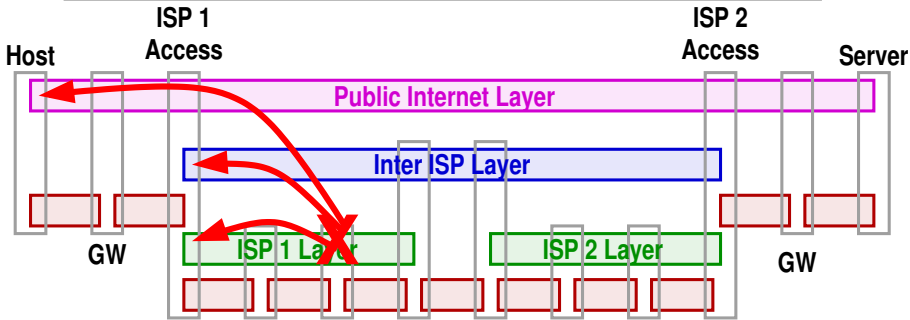
Recursive Congestion Signals



Recursive Congestion Signals



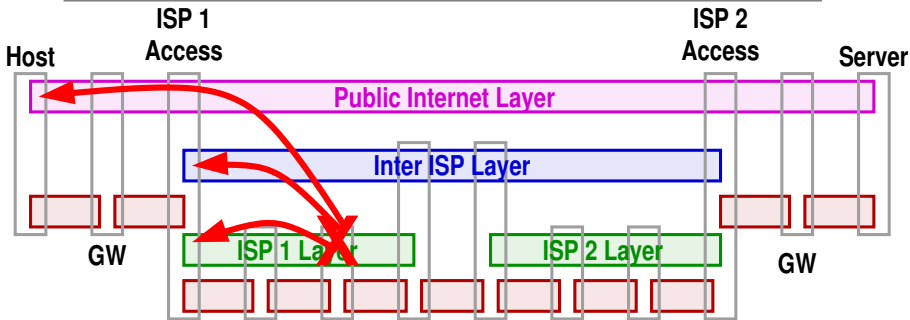
Recursive Congestion Signals



Feedback options in RINA

- Implicit:
 - ▶ Push back and push up
- Explicit:
 - ▶ Packet marking and reflection
 - ▶ Control packet notifications

Recursive Congestion Signals



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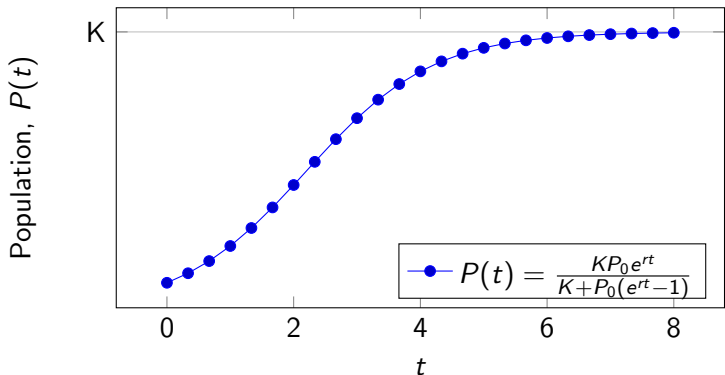
Potentially provides

- Faster responses
- Smaller buffer requirements

Cautions — Current research

- CC interactions
- Stability

Stable CC inspired by Logistic Growth in Nature



P.-F. Verhulst. [Notice sur la loi que la population poursuit dans son accroissement.](#)

Correspondance mathématique et physique, 10:113–121, 1838.

URL <http://books.google.com/?id=8GsEAAAAYAAJ>

Logistic Growth Based Congestion Control



Competition for resources

incrementally for senders:

$$x_i(t+1) = x_i(t)r_i \left(C - x_i(t) - \frac{N-1}{N} \sum_{j=1}^N x_j \right) + x_i(t)$$

Recursive layered congestion control – ongoing

- predator–prey food chain based CC
- has calculable convergence and stability properties

Conclusions and Future work



- Stability and CC interactions also relate to the current Internet
- New CC can work in the Internet as well
- Upcoming publication:
 - ▶ P. Teymoori, M. Welzl, G. Stein, E. Grasa, R. Riggio, K. Rausch, and D. Siracuss. [Congestion control in the recursive internetwork architecture \(RINA\)](#). In *IEEE International Conference on Communications (ICC), Next Generation Networking and Internet Symposium*, May 2016.
to appear
 - ▶ RINA congestion control in data centers
 - ▶ Congestion control signals and stability
- OCARINA (Optimizations to Compel Adoption of RINA)
(see <https://titan.uio.no/node/1403>)

Acknowledgements

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For more information about PRISTINE see <http://ict-pristine.eu/>

Extra slides

