



# Resource Sharing for Stateless Packet-Switched Networks

Sándor Laki

*ELTE Eötvös Loránd University, Budapest, Hungary*

[lakis@elte.hu](mailto:lakis@elte.hu)

<http://lakis.web.elte.hu>



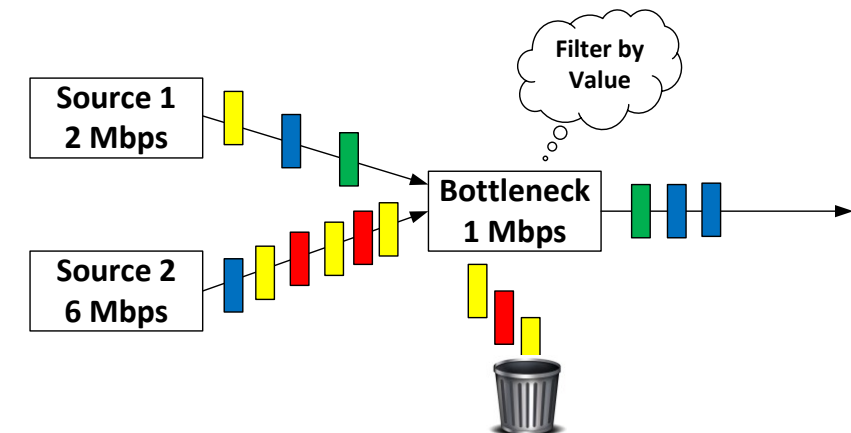
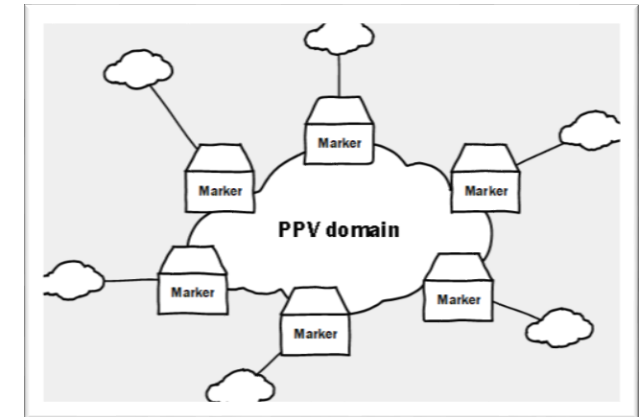
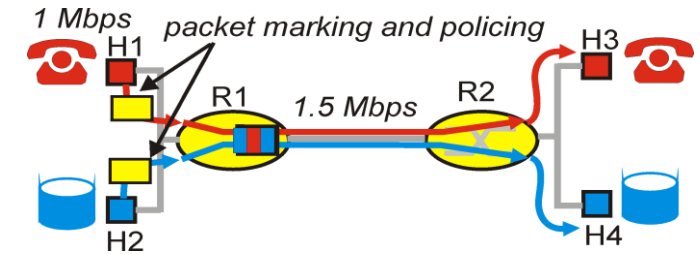
Eötvös Loránd  
University

# Problem

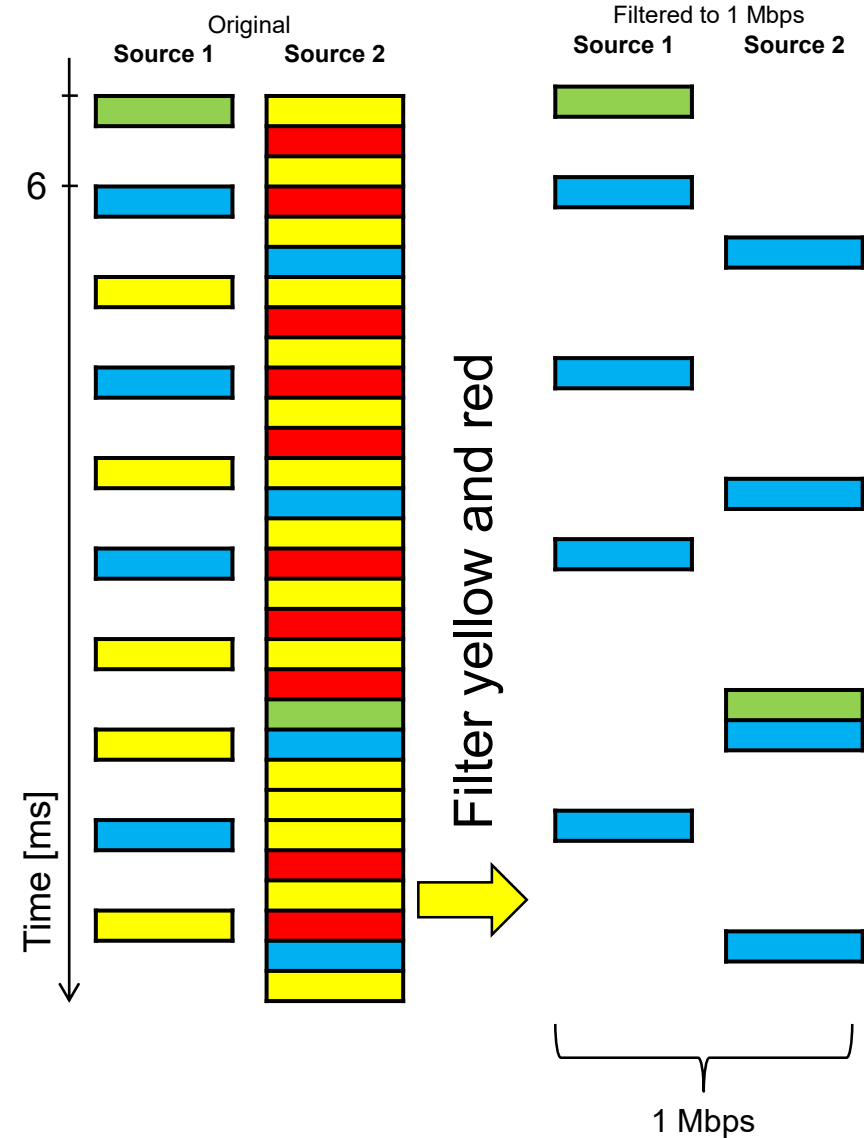
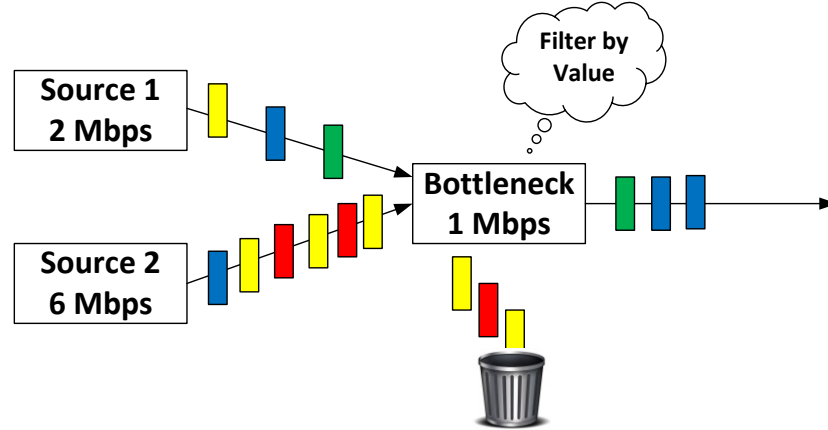
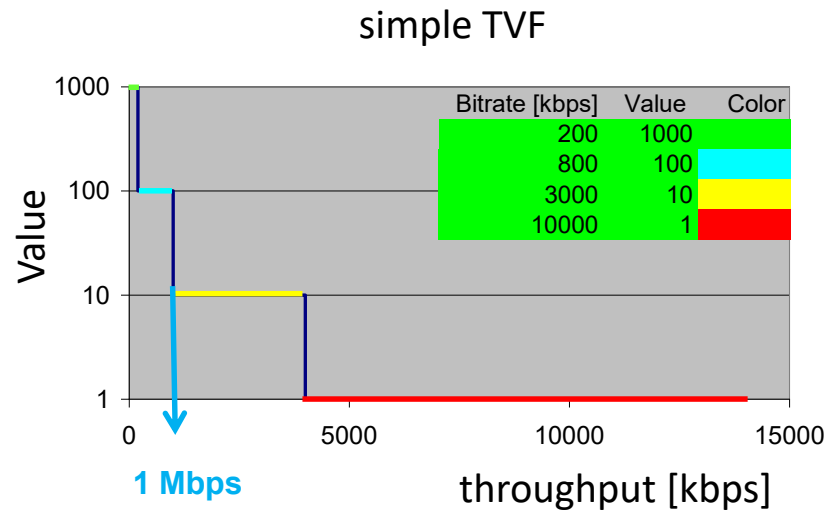
- **High speed access**
  - Mobile Access Networks, Residential Access Networks, Multi-tenant Data Centers, etc.
- Appropriate **overprovisioning** of backhaul networks
  - **Difficult & Costly**
- **Scalable** bandwidth sharing supporting **QoS** is needed in **congestion situations**
  - Simple network nodes, no per-user states, service differentiation, rich set of policies, etc.

# Per Packet Value (PPV) Resource Sharing

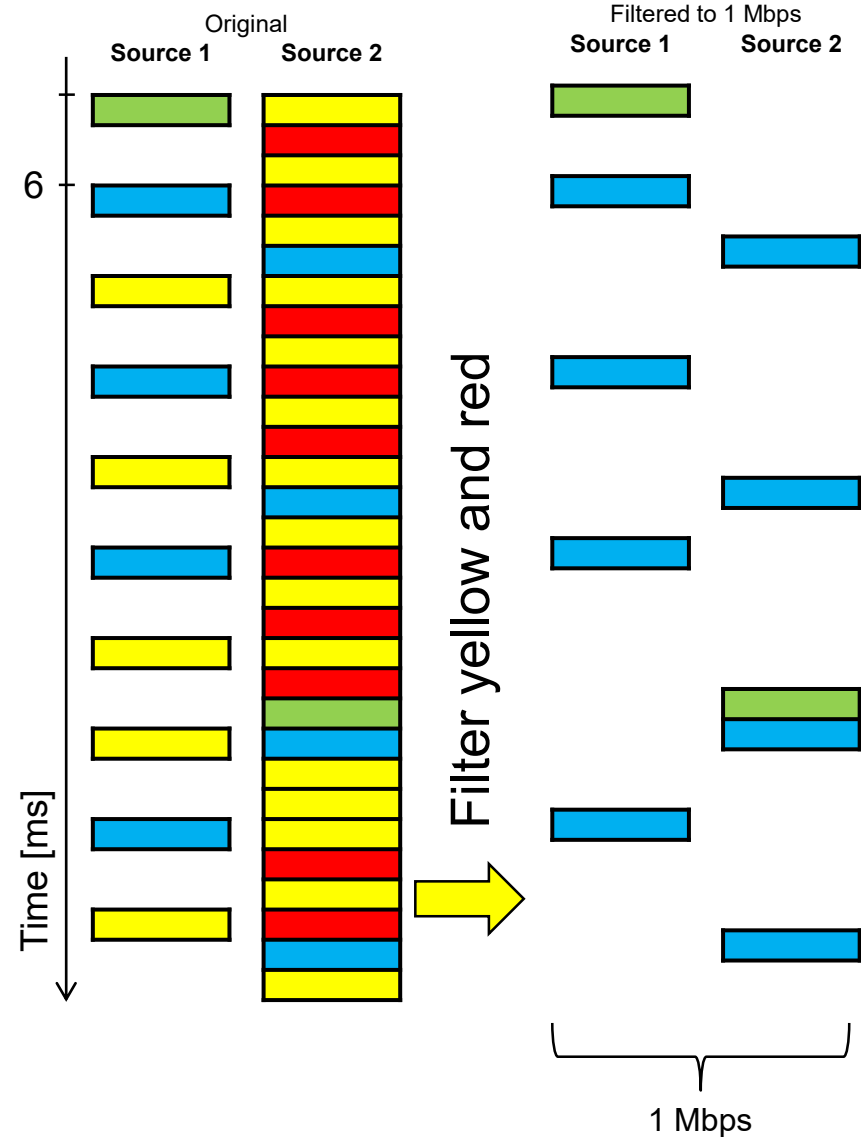
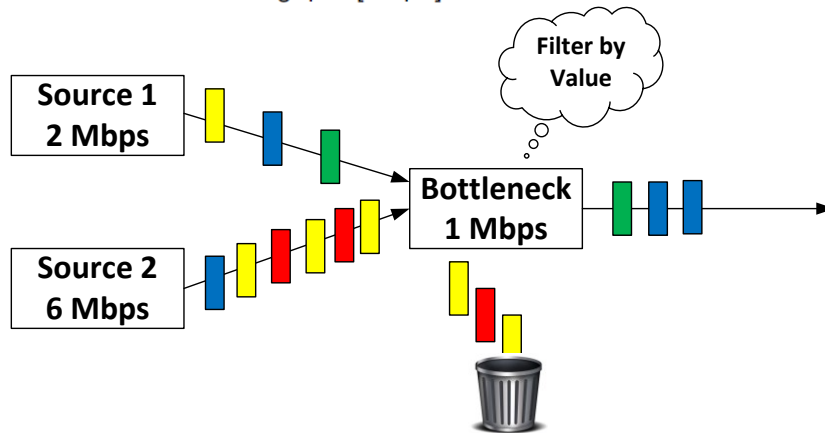
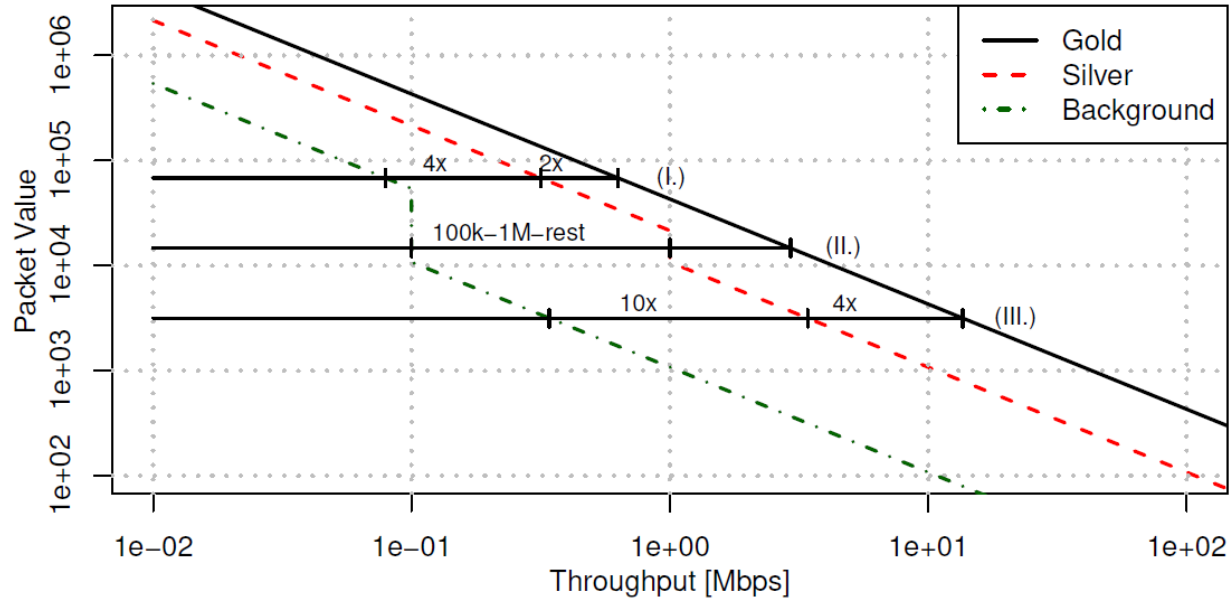
- Resource sharing policies for all congestion situations by **Throughput-Value Functions (TVF)**
- **Packet Marker** at the edge of the network
  - Stateful, but highly *distributed*
- **Resource Nodes** (e.g. routers) aim at maximizing the total transmitted Packet Value.
  - Stateless and *simple*



# PPV – Packet Marking

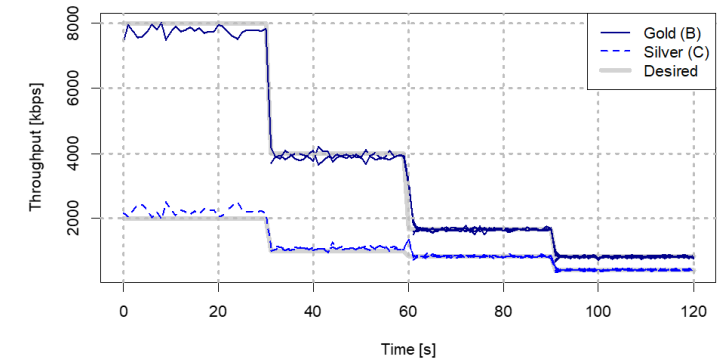
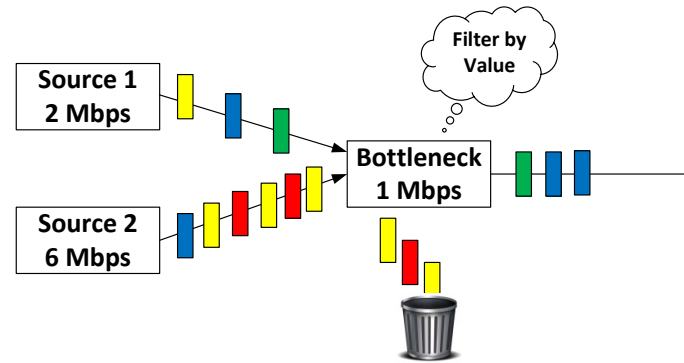


# PPV – Packet Marking

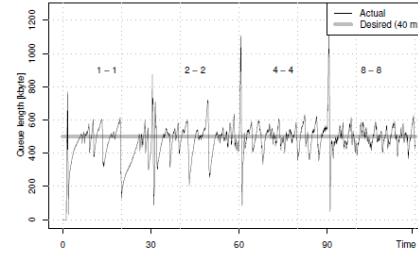
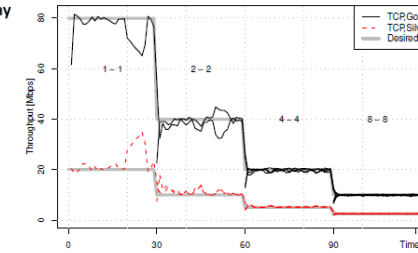
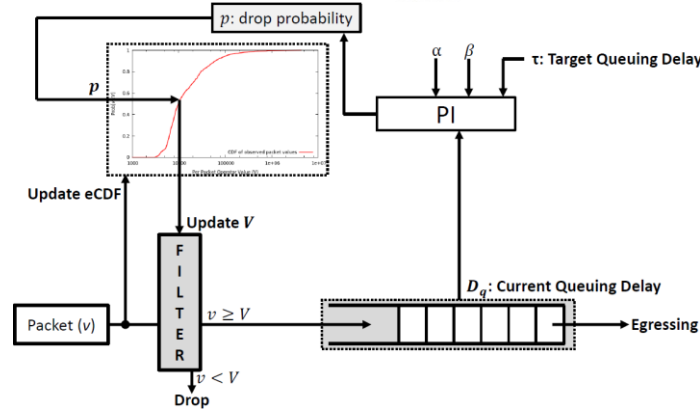


# PPV – Resource node proposals

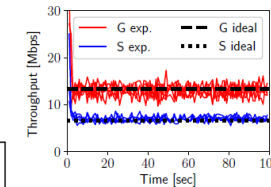
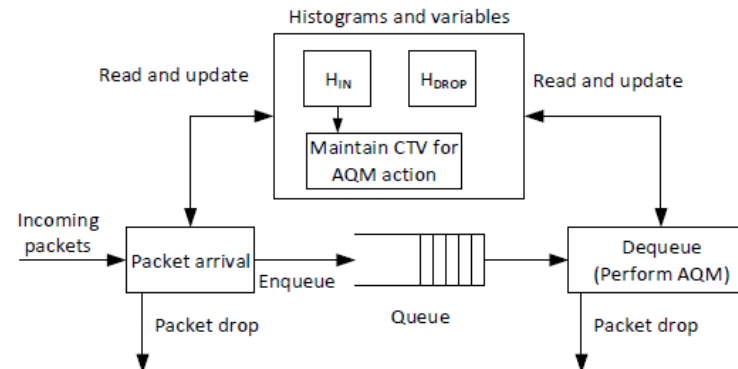
Drop minPPV first scheduling [1]



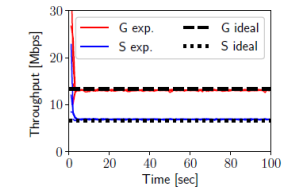
PVPIE – PPV with PIE AQM [2]



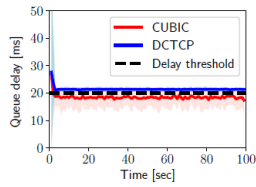
CSAQM – PPV + CC indep. AQM [3]



(a) Throughput - CUBIC



(b) Throughput - DCTCP



(c) Queueing delay

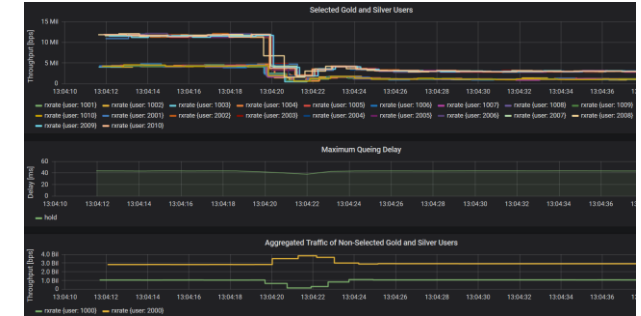
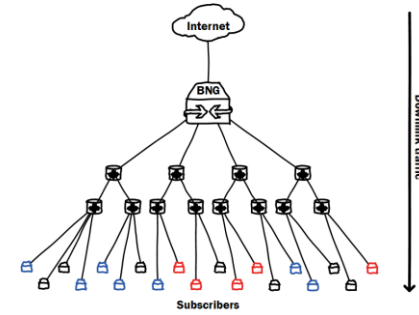
# What's next?

## Further readings

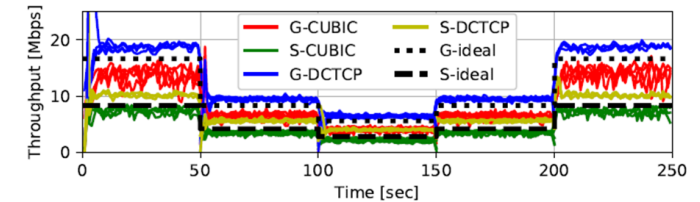
- [1] Sz. Nadas et al., Per Packet Value: A Practical Concept for Network Resource Sharing. In proc. of IEEE Globecom 2016.
- [2] S. Laki et al., Take Your Own Share of the PIE, In proc. of IRTF/ACM ANRW 2017
- [3] Sz. Nadas et al., Towards a Congestion Control-Independent Core-Stateless AQM, In proc. of IRTF/ACM ANRW 2018
- [4] S. Laki et al., Scalable Per Subscriber QoS with Core-Stateless Scheduling, Industrial demo at ACM SIGCOMM 2018

## Similar approaches published recently

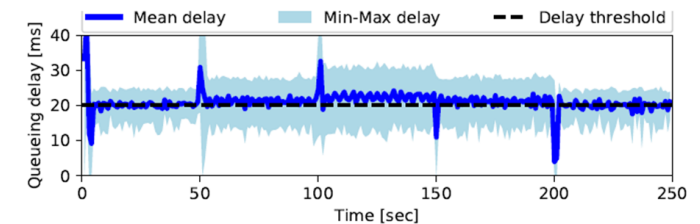
- [5] M. Menth et al, Activity-based congestion management for fair bandwidth sharing in trusted packet networks, In proc. of IEEE/IFIP NOMS 2016
- [6] M. Menth et al., Fair Resource Sharing for Stateless-Core Packet-Switched Networks with Prioritization, IEEE Access 2018.
- [7] R. Bless et al., Policy-oriented AQM Steering, In proc. of IFIP Networking 2018.



**Industrial Demo at SIGCOMM 2018**  
PPV-based Core Stateless vBNG node implementation



(a) Throughput with CSAQM



(c) Queueing delay with CSAQM

**PPV + AQM = CSAQM**  
**Poster at ANRW@IETF-102 on Monday !!!**

**Interested? Let's talk!**  
Or offline: [lakis@elte.hu](mailto:lakis@elte.hu)