

Path Awareness for Congestion Control

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Congestion Control without path awareness

- Host tries to know the path by assumption
 - packet loss → network is congested
 - RTT increase → network is getting congested
 - ACK lost for a long time → network is broken
 - ...
- Host tries to know the path by measurements
 - get more throughput by increasing sending rate → network is under light load
 - get more throughput by decreasing sending rate → network is congested
 - ...

Congestion Control with path awareness

- ECN (Explicit Congestion Notification, RFC3168, RFC5562)
Currently, ECN is the only standard way host uses the path properties feedback from network node for congestion control, it gets good throughput and latency in datacenter network with rough information.

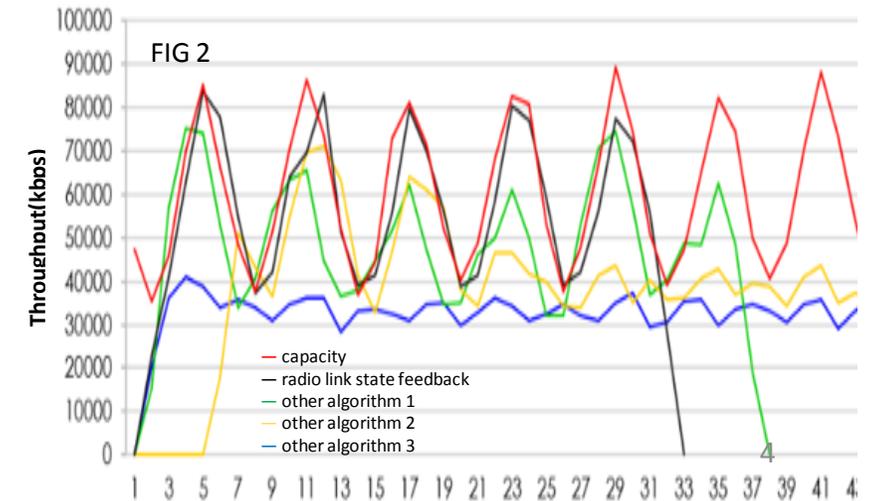
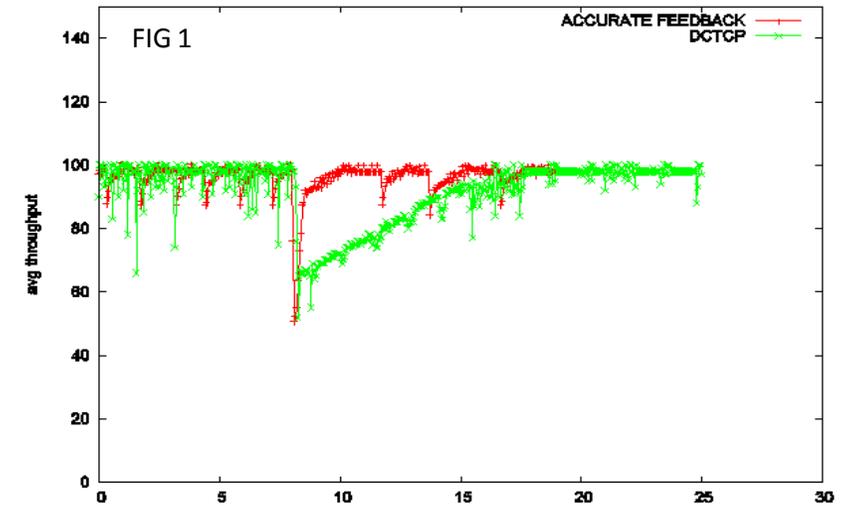
Congestion Control with path awareness – Cont.

- More rich and accurate path properties

In our research for networks, it is found that some dynamic networking information from bottleneck devices on IP path is very useful to the congestion control

- with properties such as ingress rate, egress rate, buffer length... feedback from bottleneck node, we could get higher bandwidth utilization and low latency as shown in FIG 1

- with properties of radio link state such as radio quality, spectrum utilization at a LTE base station or WIFI device, we could adapt the variable wireless network very well as FIG 2 shows



How to distribute the path properties

- ECN

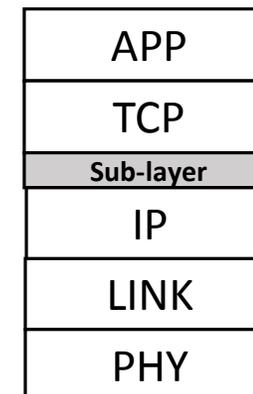
It uses two in-band bits for information distribution as IETF standard

- Rich and Accurate properties

no standard now, we use TCP and IP options for distribution

- limited by the option length
- has problems with middlebox

We prefer a standard, in-band way to distribute these properties between path (network node) and host, a specific sub-layer between TCP and IP (layer 3.5) is better.



More of path awareness

- Before path awareness

Host has no idea about the path

- After path awareness

Host knows path, then could

- select the right path
- use path more efficient

- Could we do more about the path?

Could we control the path properties?

Service like live VR/AR which needs ultimate properties (high bandwidth and low latency), this kind of flows can't only depend on the best effort network or better selection of a path, they may need to control the path properties for them, like path resource allocation as flows setup and release as flows exit.

Thank You !