Network Performance Isolation in Data Centres using ~~ConEx~~ Congestion Policing

draft-briscoe-conex-policing-01

draft-briscoe-conex-data-centre-02

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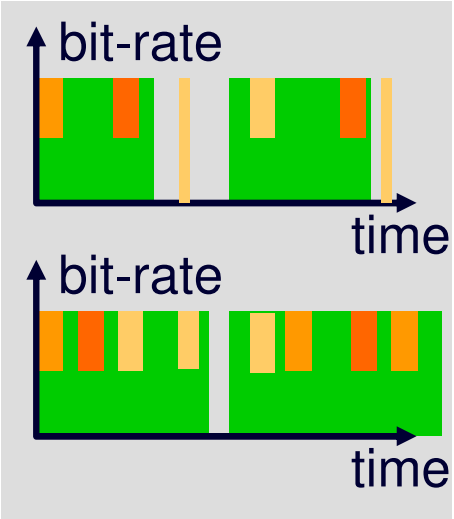
purpose of talk

- work proposal for the data centre latency control r-g
  - data centre queuing delay control
  - designed for global scope (inter-data-centre,... Inter-net)
  - this talk: adds first step: intra-data centre
    - without any new protocols

- started in the IETF congestion exposure (ConEx) w-g
- generalised for initial deployment without ConEx
  - and even without ECN end-to-end
  - now even without ECN on switches (in slides, not draft)

Network Performance Isolation in Data Centres

- An important problem
  - isolating between tenants, or departments
  - virtualisation isolates CPU / memory / storage
  - but network and I/O system is highly multiplexed & distributed
- SDN-based (edge) capacity partitioning*
  - configuration churn: nightmare at scale
  - poor use of capacity
- edge-based weighted round robin (or WFQ)
  - More common
  - but biases towards heavy hitters (no concept of time)



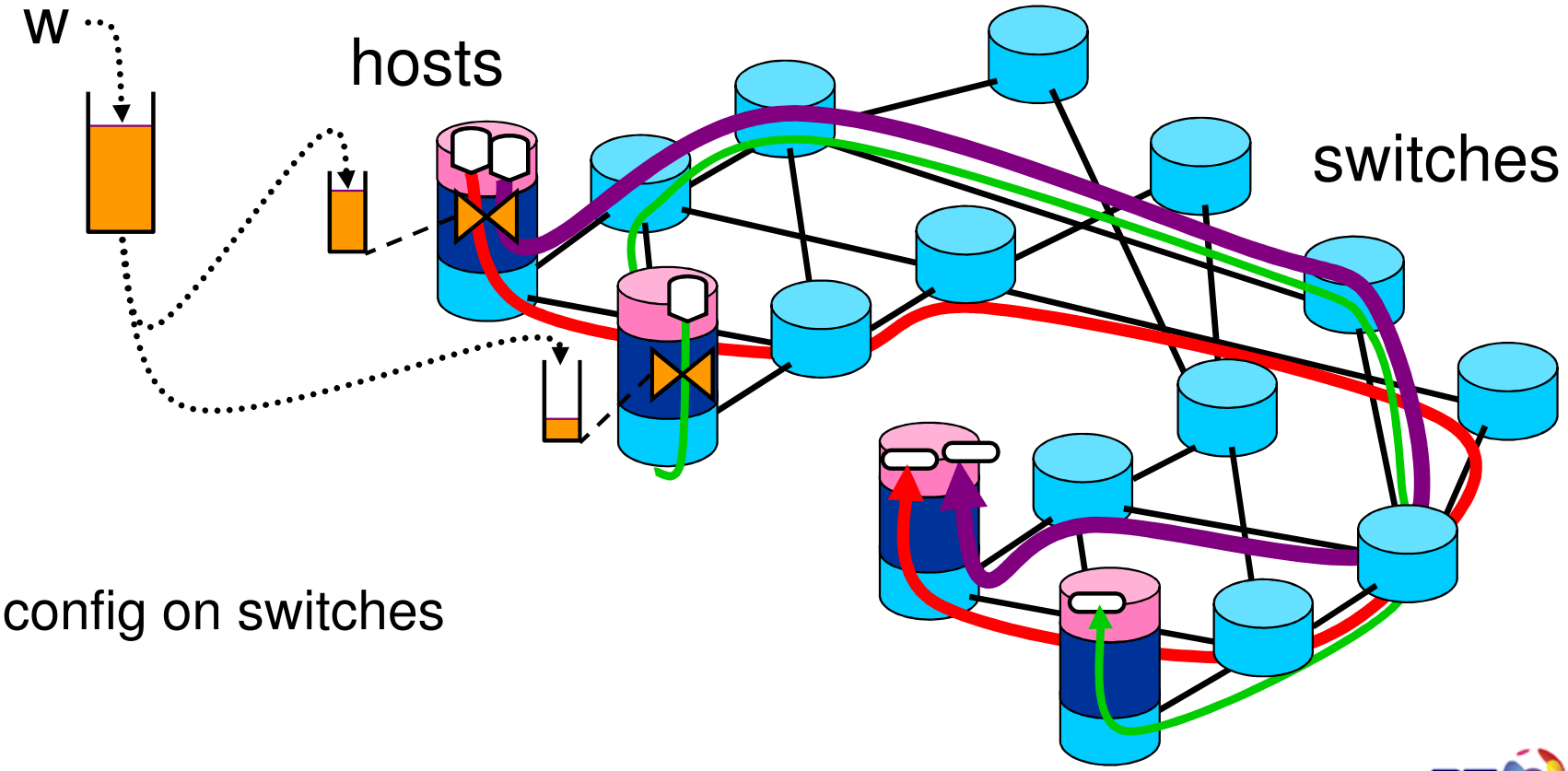
* every problem in computer science can be solved by not thinking then hiding the resulting mess under a layer of abstraction

Outline Design – First Step
edge bottlenecks by capacity design

VM sender
VM receiver
congestion policer

guest OS
hypervisor
switching

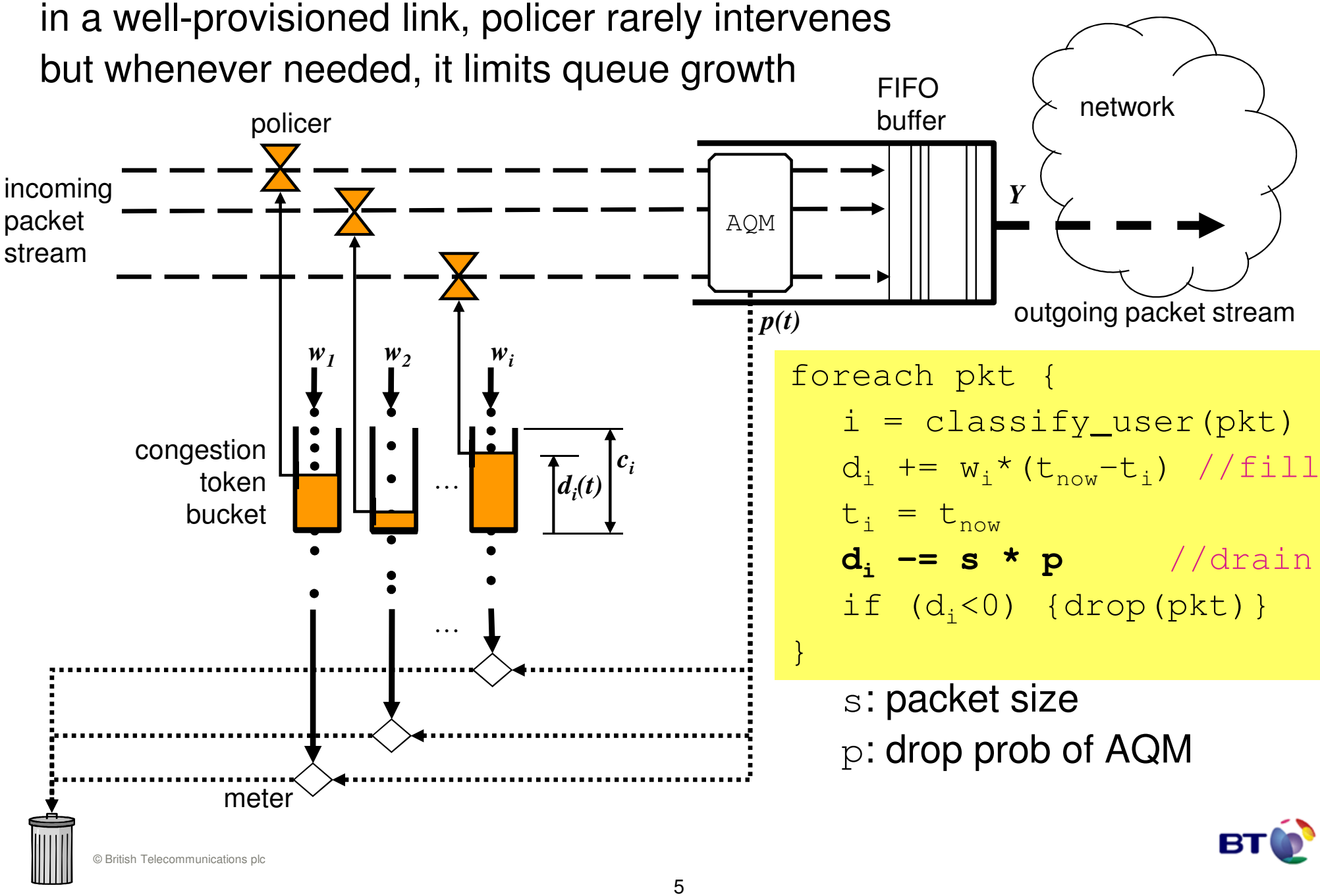
- Edge policing like Diffserv
  - but congestion policing (per guest)
- isolation within FIFO queue



- no config on switches

bottleneck congestion policer

- in a well-provisioned link, policer rarely intervenes
- but whenever needed, it limits queue growth

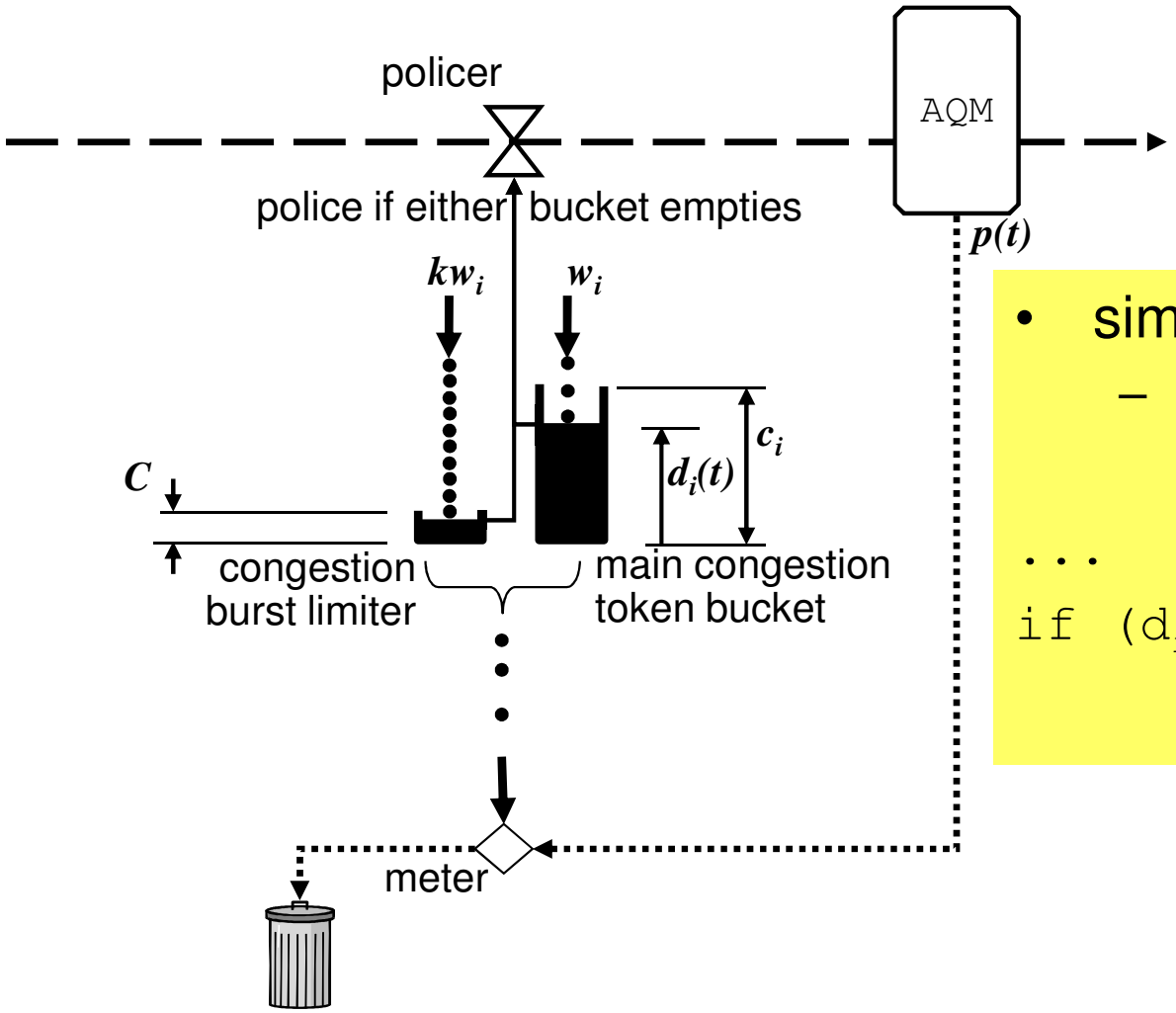



```
foreach pkt {
    i = classify_user(pkt)
    d_i += w_i*(t_now-t_i) //fill
    t_i = t_now
    d_i -= s * p          //drain
    if (d_i<0) {drop(pkt)}
}
```

s: packet size

p: drop prob of AQM

actually each bucket needs to be two buckets to limit bursts of congestion



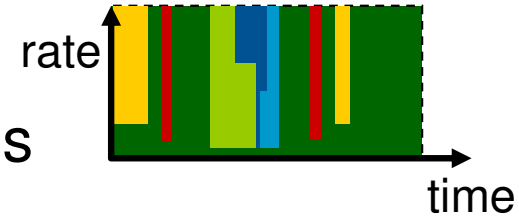
- similar code
  - except 2 token buckets

```
...
if (d_i1<0 || d_i2<0)
        {drop(pkt)}
```

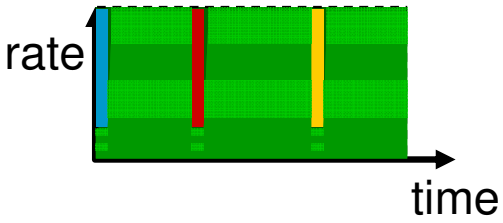
performance isolation outcome

- WRR or WFQ

- congestion policer
  - with unequal traffic loads



- congestion policer
  - treats equal traffic loads equivalently to WRR

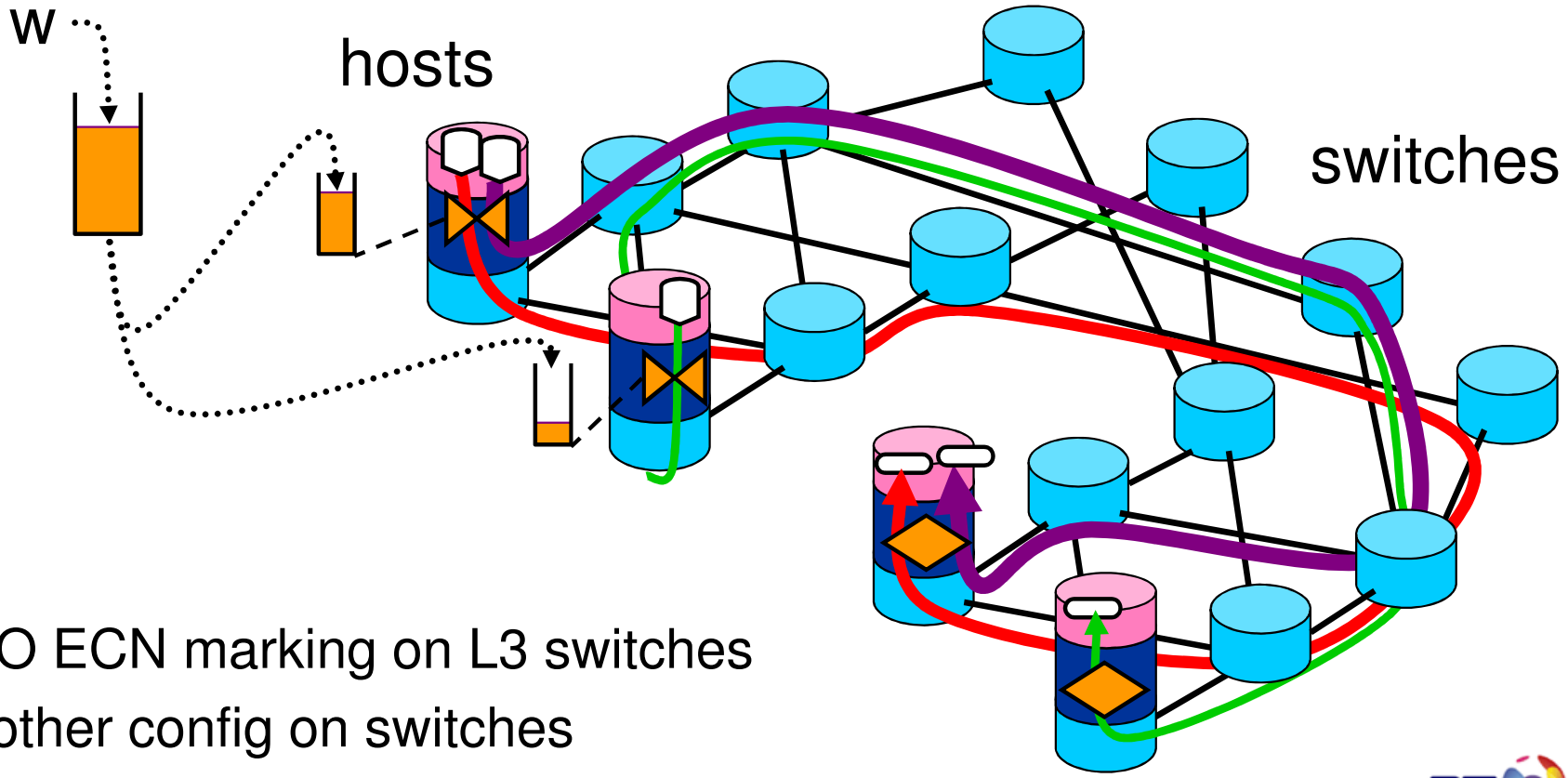


Outline Design
edge and core queue control

VM sender
VM receiver
TEP / congestion policer
TEP / audit

guest OS
hypervisor
switching

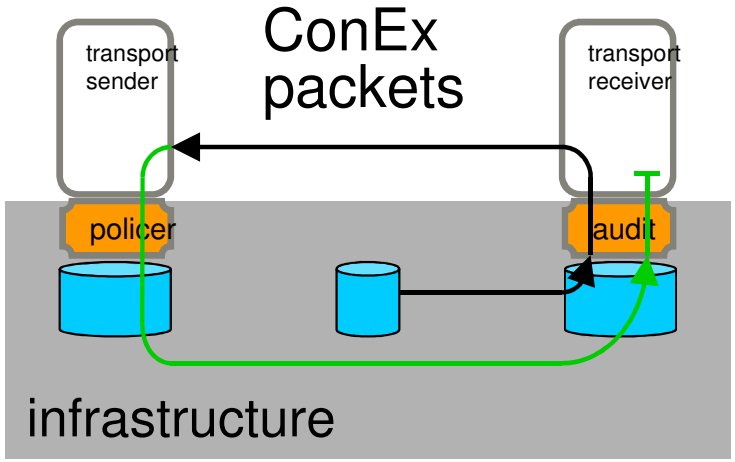
- Edge policing like Diffserv
  - but congestion policing (per-guest)
- Hose model
- intra-class isolation in all FIFO queues

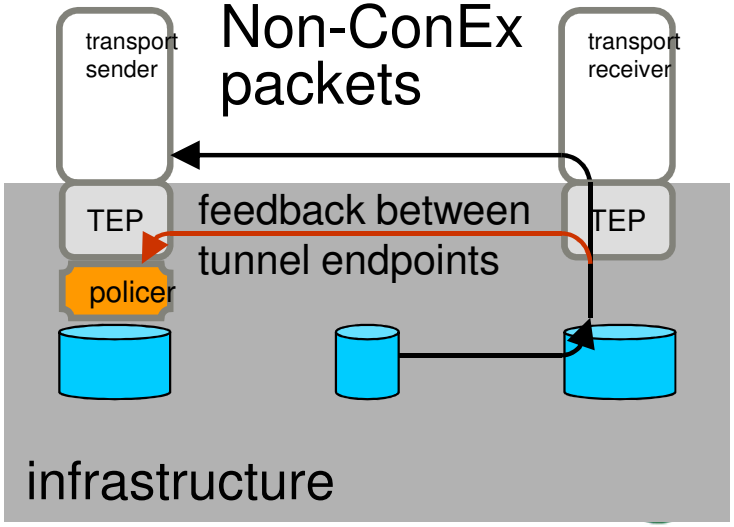


- FIFO ECN marking on L3 switches
- no other config on switches

trusted path congestion feedback

- Initial deployment
  - all under control of infrastructure admin
- ECN on guest hosts: optional
  - ECN enabled across tunnel
- ConEx on guest hosts: optional
  - any ConEx-enabled packet doesn't require tunnel feedback
- details – see spare slide or draft





Features of Solution

- Network performance isolation between tenants
- No loss of LAN-like multiplexing benefits
    - work-conserving
- Zero (tenant-related) switch configuration
- No change to existing switch implementations
- Weighted performance differentiation
- Simplest possible contract
    - per-tenant network-wide allowance
    - tenant can freely move VMs around without changing allowance
    - sender constraint, but with transferable allowance
- Transport-Agnostic
- Extensible to wide-area and inter-data-centre interconnect

call for interest

- implementation in hypervisors
- evaluation

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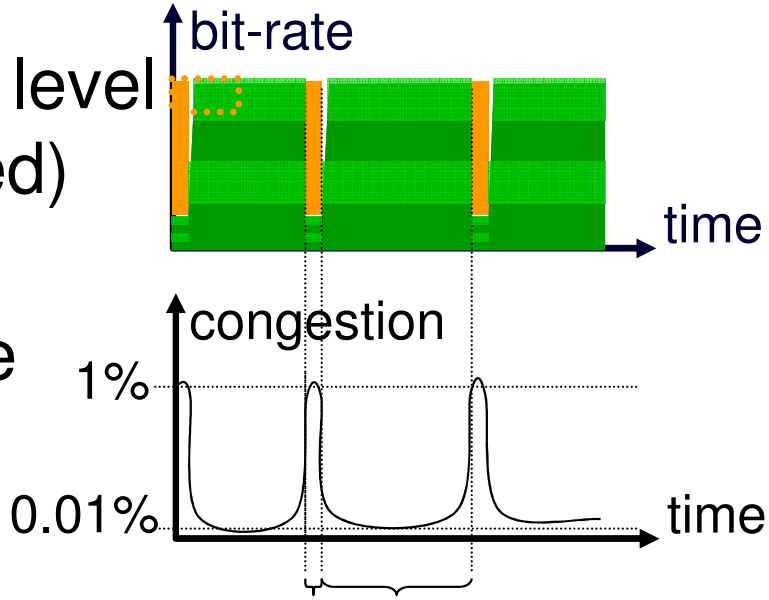
Q&A

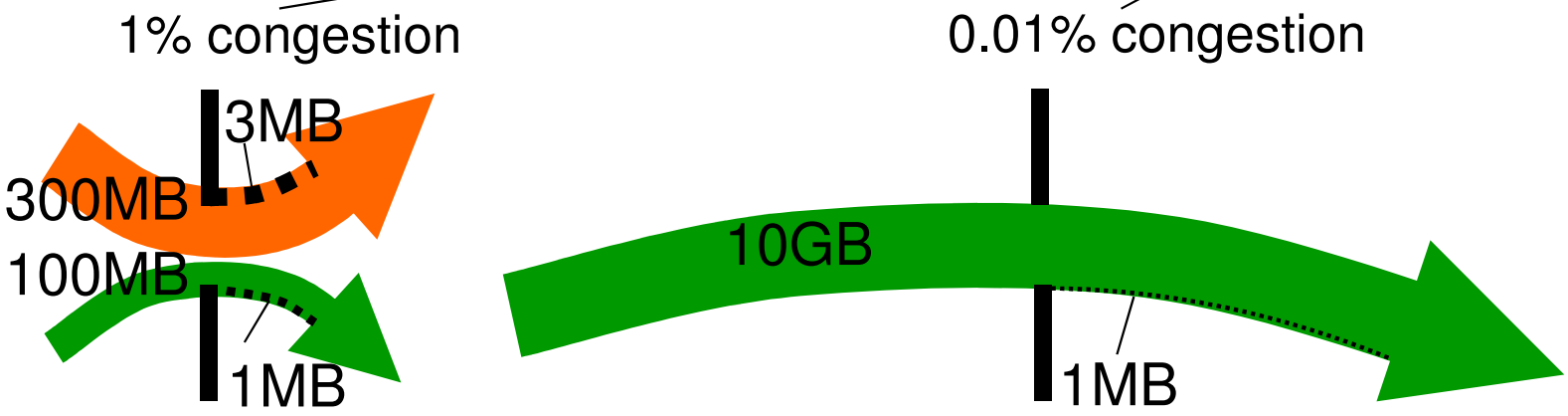
& spare slides

measuring contribution to congestion

= bytes weighted by congestion level
= bytes dropped (or ECN-marked)
= ‘congestion-volume’

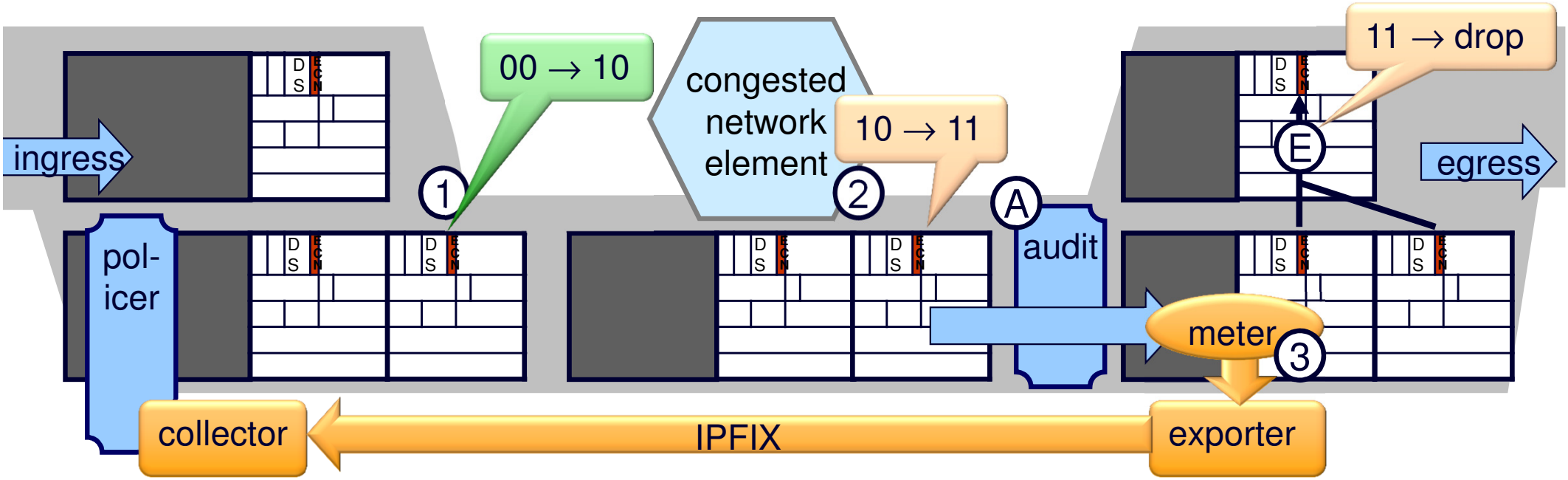
as simple to measure as volume





unilateral deployment technique for data centre operator

- exploits:
  - widespread edge-edge tunnels in multi-tenant DCs to isolate forwarding
  - a side-effect of standard tunnelling (IP-in-IP or any ECN link encap)



- for e2e transports that don't support ECN, the operator can:
  - ① at encap: alter 00 to 10 in outer
  - ② at interior buffers: turn on ECN
- defers any drops until egress Ⓔ
- audit Ⓐ just before egress can see packets to be dropped

- for e2e transports that don't support ConEx, the operator can create its own trusted feedback:
  - ③ at decap: *only* for Not-ConEx packets, feedback aggregate congestion marking counters:
    - CE outer, Not-ECT inner = loss
    - CE outer, ECT inner = ECN