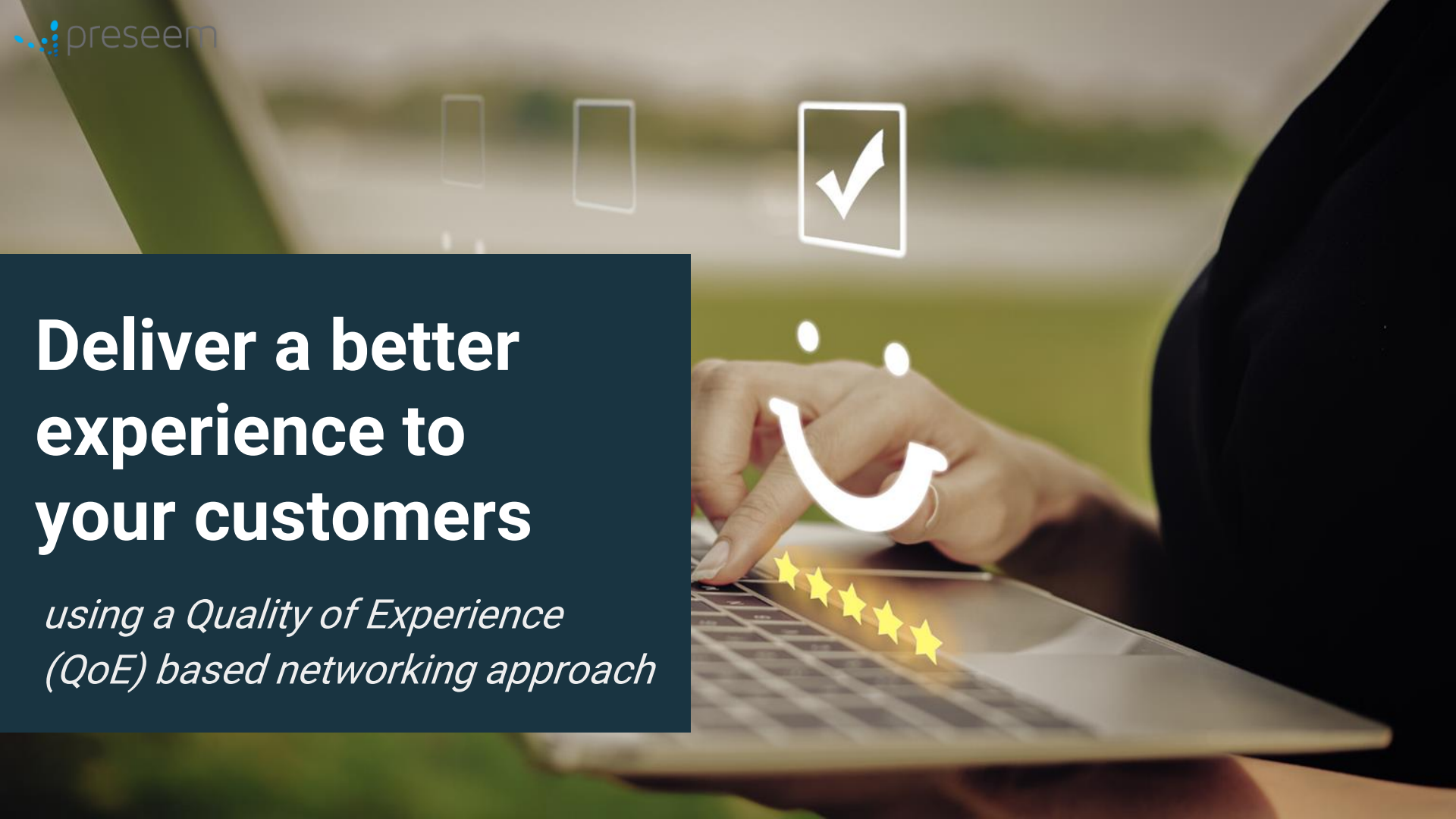
preseem

Deliver a better experience to your customers

using a Quality of Experience (QoE) based networking approach



preseem

Gerrit Nagelhout

gerrit@preseem.com

- Previously developed products and managed engineering teams for products deployed in some of the largest ISPs in the world
- Co-founder & CEO of Aterlo Networks
- Helping WISPs understand & improve QoE on their networks with Preseem

Agenda

- What is Quality of Experience (QoE)?
- QoE vs traditional network monitoring
- How to measure QoE
- Examples of poor QoE
- Shapers & optimizing QoE

What is Quality of Experience (QoE)?

- Measures how your customers experience your service.
- The main factors impacting QoE are
  - Bandwidth (are people getting their plan speed?)
  - Latency/Jitter (Without having to wait for packets)
  - Loss (Or losing many along the way)
- Bandwidth typically gets the most attention, but latency is often more important

Poor QoE results in generally slow-feeling internet even though traffic is flowing

Common Causes of Poor QoE in Fixed Wireless

- Shapers / plan enforcement
- Last mile connectivity (trickiest / most variability)
  - Access Points & CPE Connections
    - Overloaded
    - Underperforming (interference, NLoS, etc)
  - In home WiFi
- Backhauls
- Less Common (but high impact)
  - Transit capacity & overloaded Mikrotiks

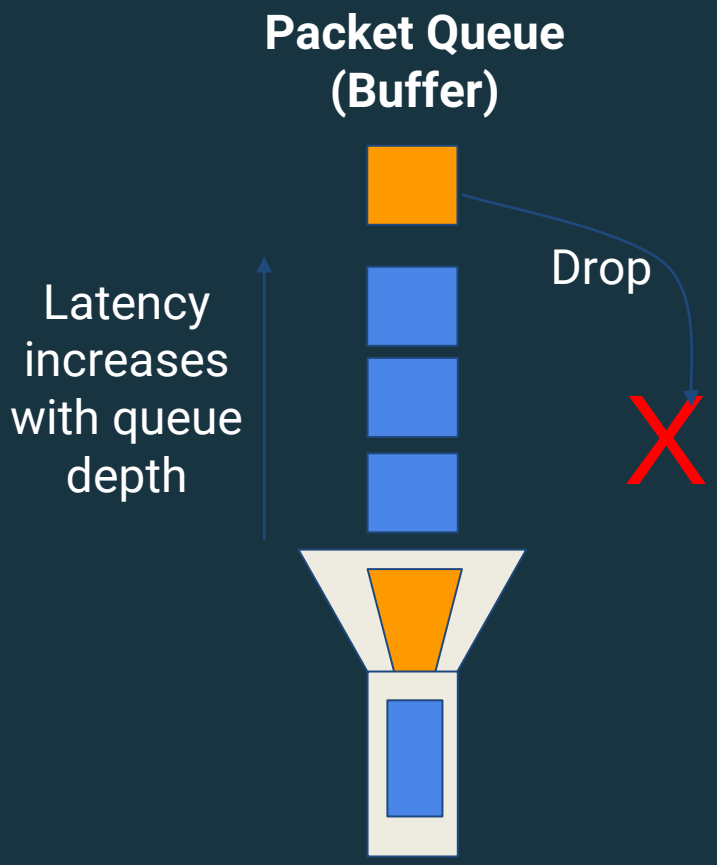
Network Monitoring

Traditional network monitoring is focused on up/down and status as reported by the network elements

This is important … but not sufficient.

Are those elements actually delivering a good end user experience?

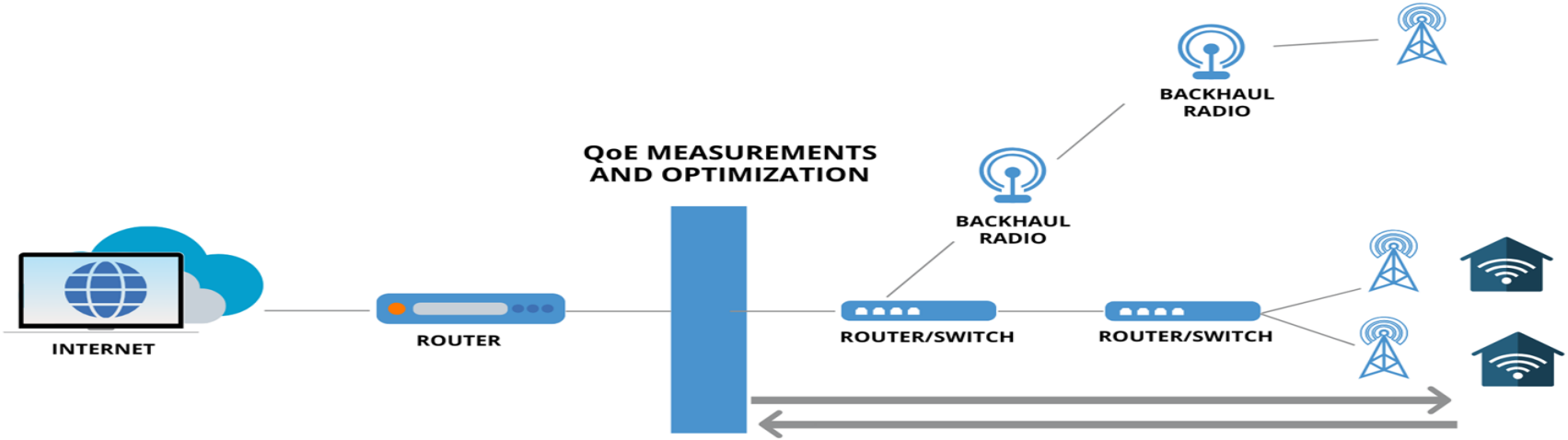
Finding Bottlenecks



- QoE issues are ultimately caused by bottlenecks
- The existing (TCP) traffic on your network has built in mechanisms to detect this
  - TCP Round Trip Time (latency)
  - TCP Retransmits (loss)
- **Note that ICMP/Ping latency is not the same thing**.

Measure - QoE from Subscriber Traffic

- Fine grained QoE metrics collected directly from the actual traffic for every IP address
  - Latency (>> samples), loss, throughput, …
  - End-to-end (into home)
- Aggregated to provide view of QoE by subscriber and access element



- QoE metrics are augmented by other data sources such as billing system integrations and SNMP to network elements

Analyze - Access Point Capacity Planning

Oversubscribed / Underperforming

Few Users/Low Bandwidth

Fix to avoid:
- Support calls
- Churn
- Negative Reviews

Consider sector shaper to mitigate impact on experience

Edge of good experience
Stop Sell or improve / add capacity

Sell

Access Point Status

preseem

Pro-active Network Improvements

Wireless		Metrics						
Tower	Sector	Latency (ms)	Busy Hours	Oversubscription Ratio	Downstream (mbps)	Upstream (mbps)	Active Subscribers	Connected Stations
Woodard Tower	Woodard SE Cambium Sector	83	0.03	7.19	42.76	7.68	8	23
Hayes Tower	Hayes Tower S Horn	157	0.03	7.02	49.17	3.46	14	29
Parkdale	Parkdale Cambium Sector SW	88	0.02	6.88	36.01	3.09	9	20
Parkdale	Parkdale Cambium Sector NW	113	1.63	6.79	59.19	4.75	14	26
Marina-Eisenhower	Eisenhower Marina Sector	70	0	6.65	16.71	2.25	3	18
Slate Tower	Slate Tower West Sector	70	0	6.49	33.42	12.48	7	23
NTRA	NTRA-NWSector	98	0	6.11	36.22	6.74	8	21
Howe Water Tower	Howe NE Sector	93	0	5.85	36.09	2.66	6	16
Woodard Tower	Woodard NE Cambium Sector	82	0.03	5.75	31.18	4.81	8	20
NTRA	NTRA West Sector	105	0	5.65	36.82	3.54	8	20
WW Hwy 160	WWHwy160 330 Horn	98	0.07	5.46	64.19	5.02	13	26
MicroPOP-Southmayd Meadows	Southmayd Tower Sector	134	2.65	5.2	61.41	3.56	12	18
Howe Water Tower	Howe SE Sector	76	0	5.12	30.89	2.7	8	16
NTRA	NTRA-SW Sector	148	0	5.08	41.3	3.07	10	17
Lankford Tower	Lankford Tower Omni	83	0.03	5.08	28.95	4.83	5	13
WW Hwy 160	WWHwy160 210 Horn	74	0	4.97	29.86	21.15	9	17
Howe Water Tower	Howe Water Tower NE Overload Horn	104	0	4.96	42.7	2.85	8	15
Gun Club Rd Tower	Gun Club Sector 2	81	0.58	4.75	39.61	3.42	6	13
MicroPOP-Tarpley Tower	Tarpley Tower SSE Sector	67	0.03	4.52	27.79	2.72	5	10
SWTBL (Barbara Lane)	SWTBL SE Sector	68	0	4.51	31.2	4.79	6	14

Quickly find Access Points that are

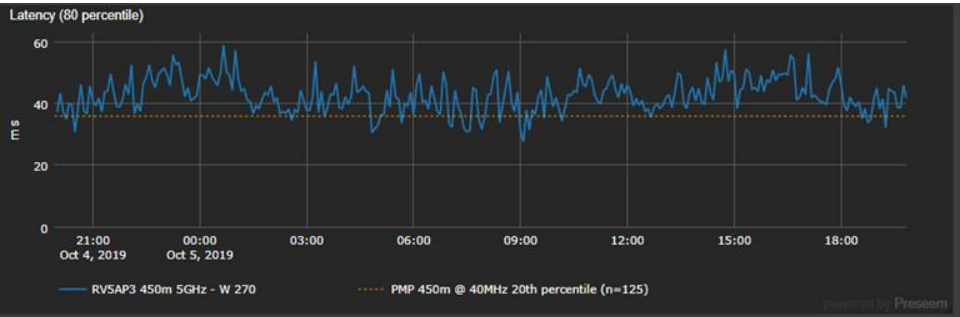
- Overloaded or
- Underperforming

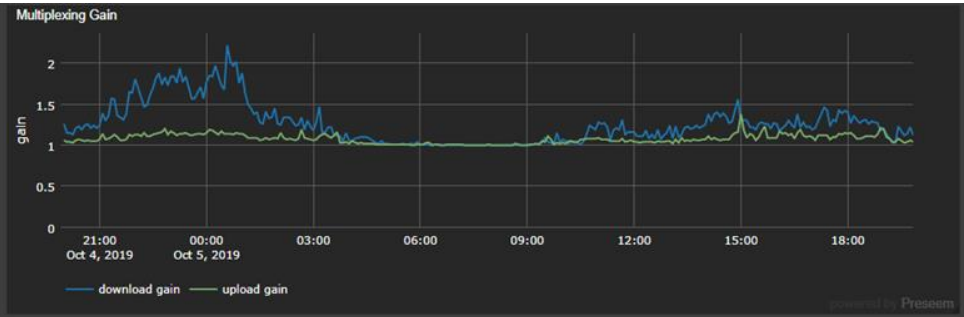
As well as those ready for more subscribers

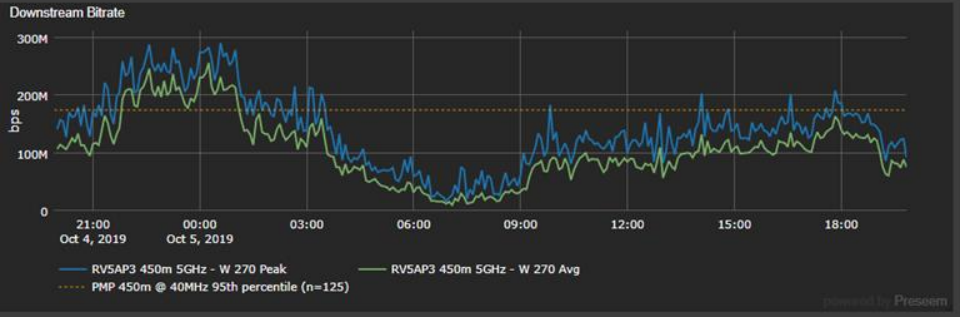
Access Point with Interference

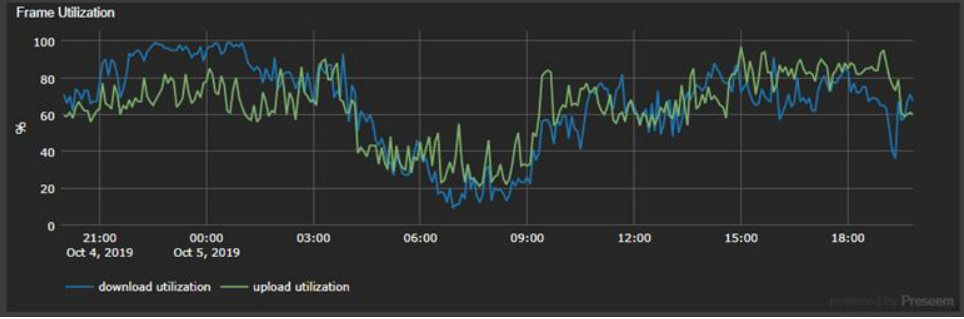
- Ubiquiti Rocket 5AC PtMP
- Sharply increased latency together with reduced throughput immediately indicates an underperforming AP
- Airtime generally follows the throughput, but doesn't indicate issues during this time
- This turned out to be severe interference and channel was changed. AP was later replaced with a gen 2 Prism to better handle noise.

Hard Working Medusa









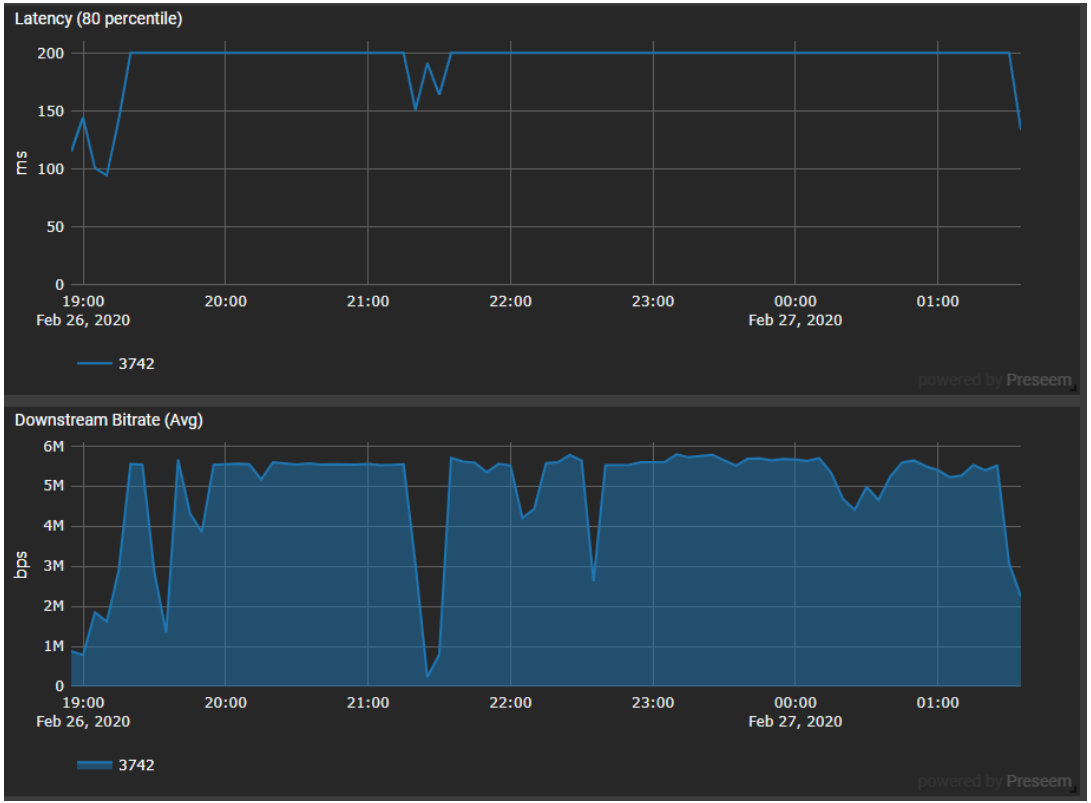
- Cambium 450m @ 40Mhz. 89 stations
- Frame utilization nearing 100% which normally indicates trouble for Cambium
- Latency is fine however. Throughput exceeds typical. QoE looks great!
- 450m has MU-MIMO … Multiplexing Gain kicking in

Using QoE Data for Customer Support

QoE data can quickly answer questions such as:

- Does this subscriber have a quality or bandwidth issue?
  - Requires a fix vs a plan upgrade
- If a quality issue, is the problem with the
  - Backhaul
  - Access Point or
  - Customer specific (bad connection or in home WiFi)

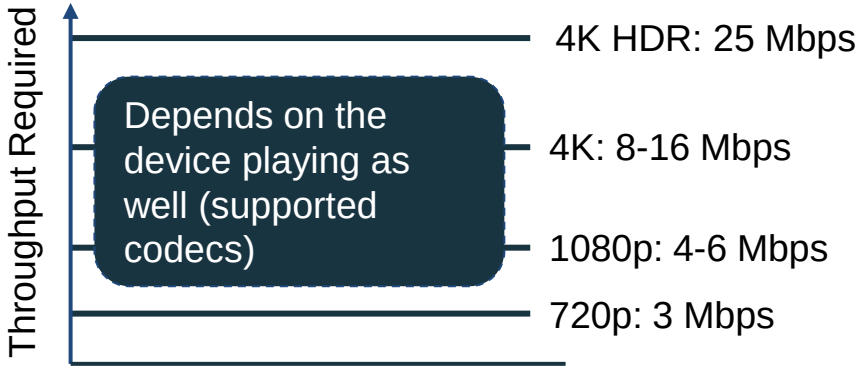
Plan Enforcement - The Problem



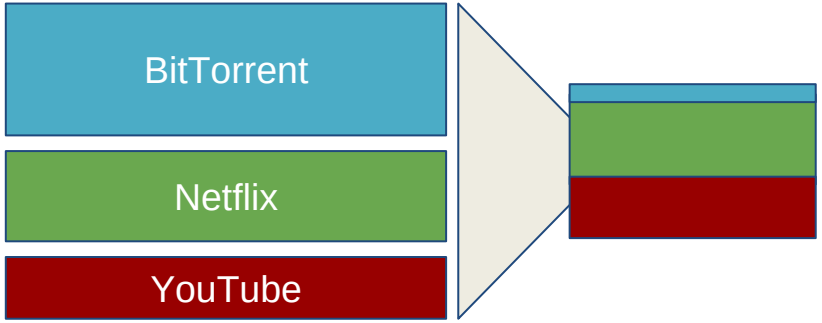
- Bandwidth shapers limit customers to the plan they have purchased (eg 5/1Mbps)
- Simple shapers use one large queue with all packets being treated equally
- When the queue fills up, all traffic is delayed making applications such as gaming, VoIP & browsing work poorly resulting in “my internet is slow” calls

One Approach - Application-Aware Enforcement

Identify and limit bandwidth intensive applications

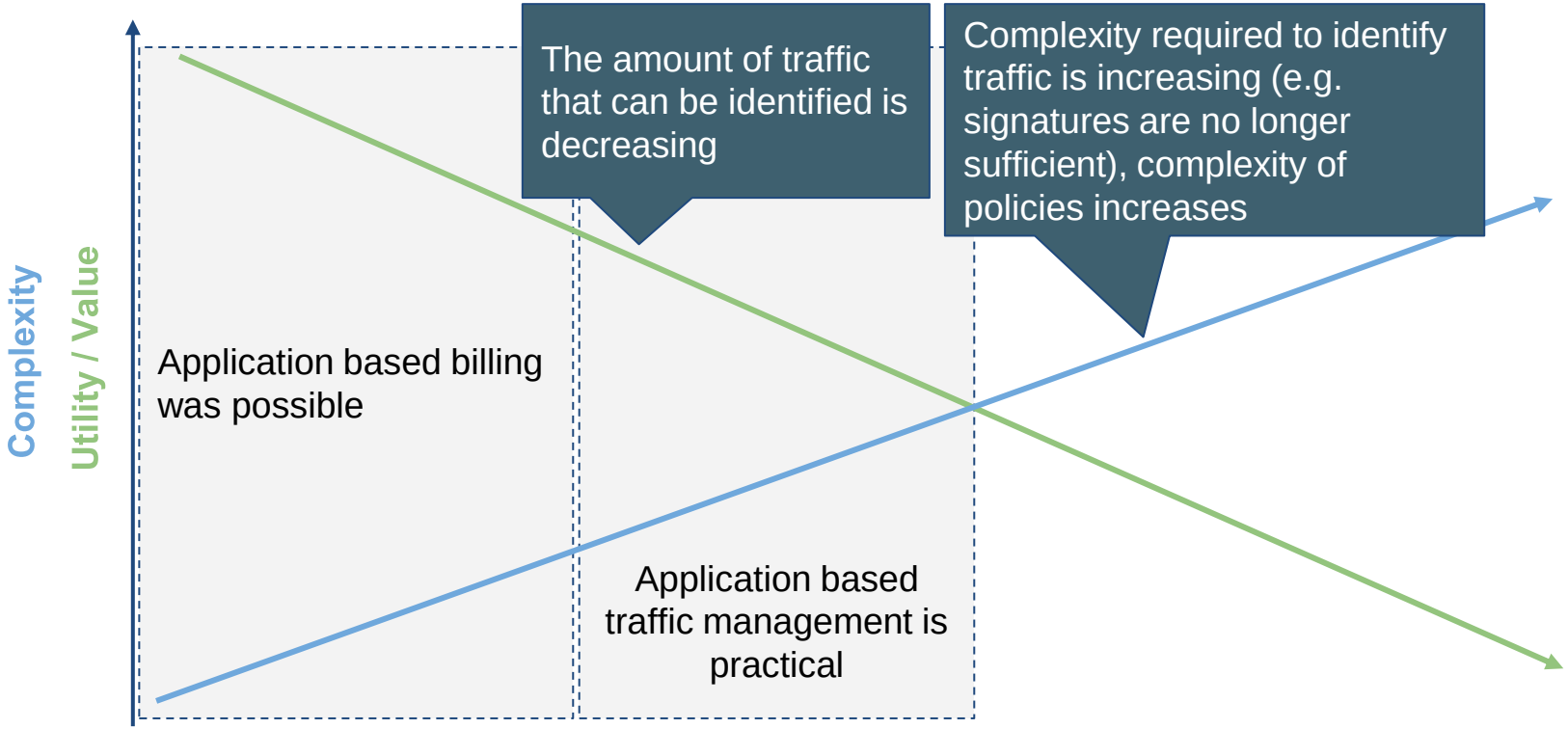


- What % of a subscriber's plan should be left free (Netflix shaped) to ensure other applications work well?
- When managing a link, what % of the link will give all customers at least HD?



- All three are ways to consume live/streaming video
- Choosing to de-prioritize BitTorrent is in effect, choosing for the subscriber

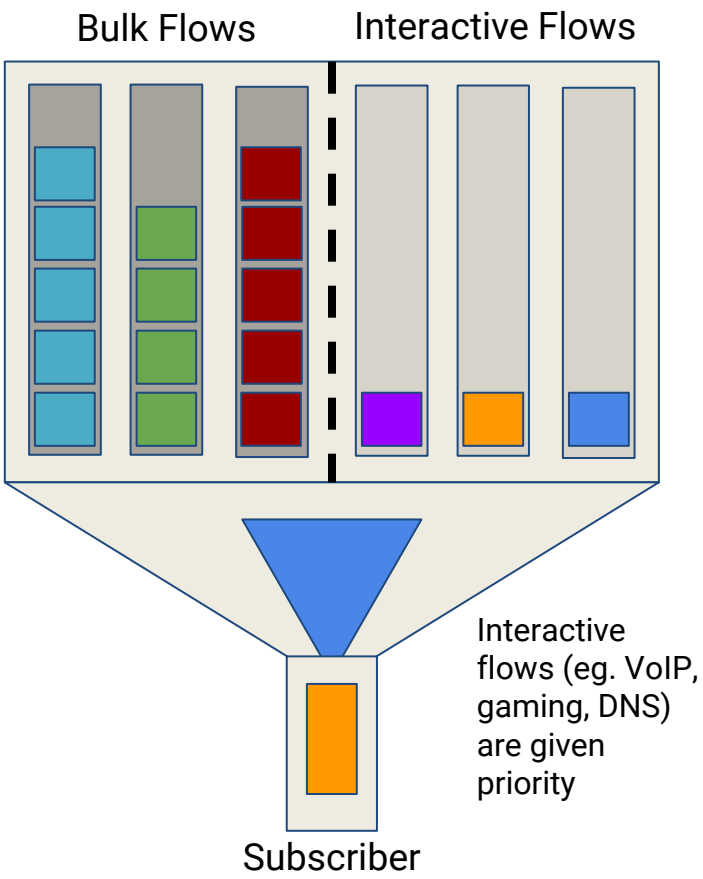
Application-Based Traffic Management



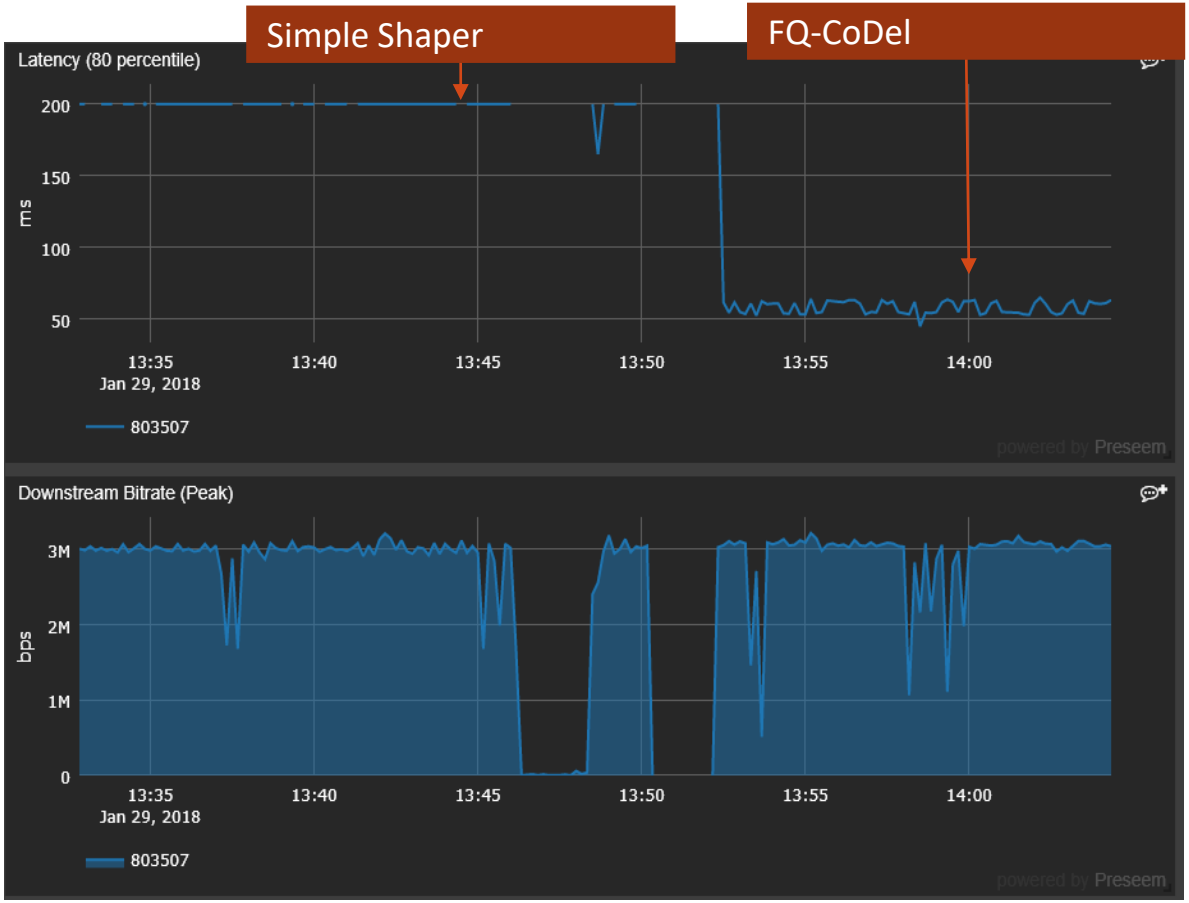
Standards Based Optimization

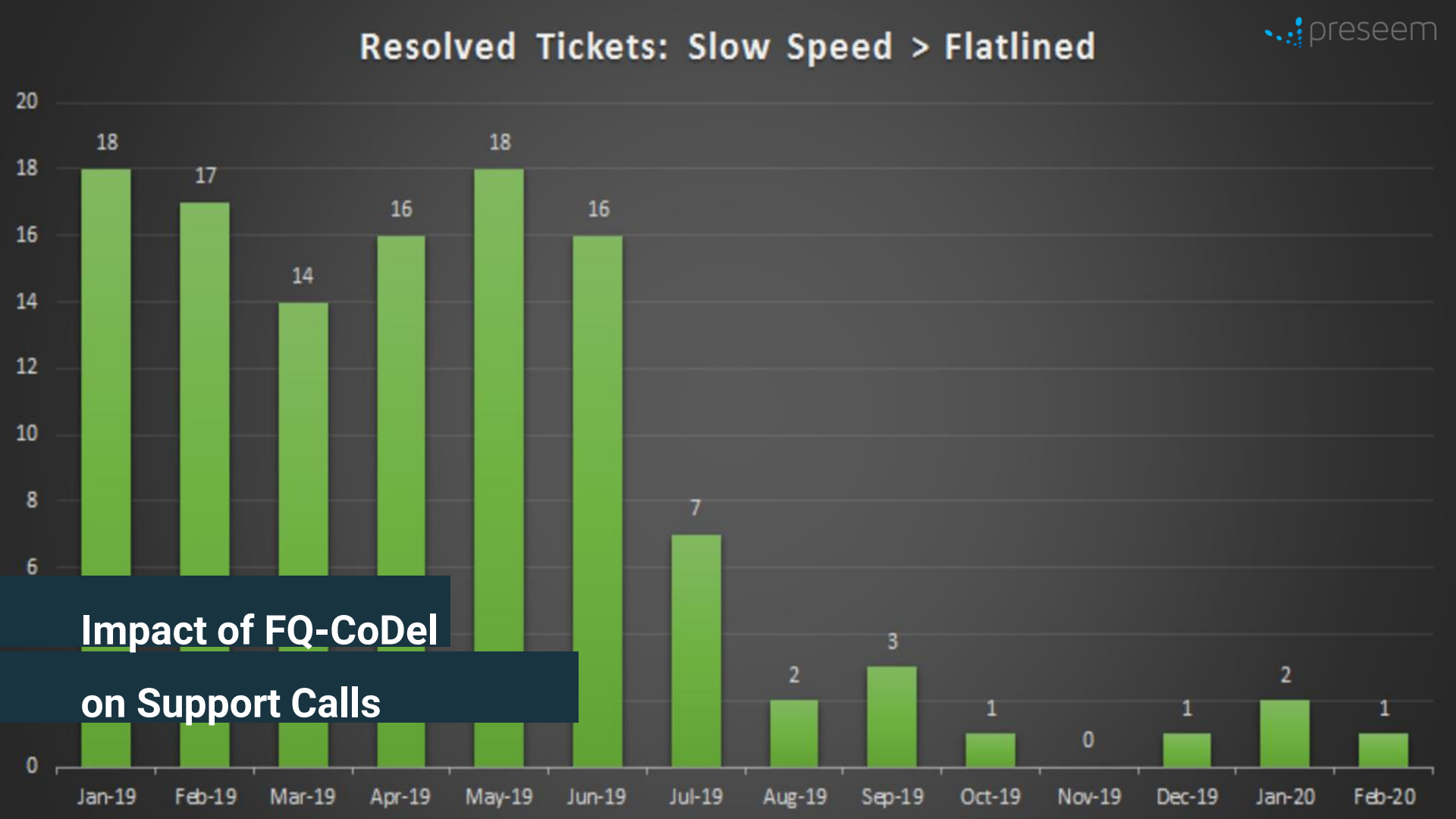
FQ-CoDel (IETF Standard)

- Traffic is automatically classified into Bulk vs Interactive flows based on their behavior
- Low latency
  - Interactive flows get priority
  - Flow isolation limits interaction
  - Active Queue Management
- Can be applied at subscriber, sector & link level
- Fixes “my internet is slow” calls when connection is maxed out



Improve - Latency Under Load




Resolved Tickets: Slow Speed > Flatlined
preseem
20
18
16
14
12
10
8
6
0
18
17
14
16
18
16
7
2
3
1
0
1
2
1
Jan-19
Feb-19
Mar-19
Apr-19
May-19
Jun-19
Jul-19
Aug-19
Sep-19
Oct-19
Nov-19
Dec-19
Jan-20
Feb-20
Impact of FQ-CoDel
on Support Calls

Deliver a Better Experience to your Customers

- ➔ Find & Fix bottlenecks
- ➔ Implement smart shapers
- ➔ Reduce support calls & churn

Thank You!

Does anyone have any questions?

gerrit@preseem.com
1833-PRESEEM
preseem.com