



IS-IS Traffic Engineering Extensions for Microburst Metrics

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1 China Unicom

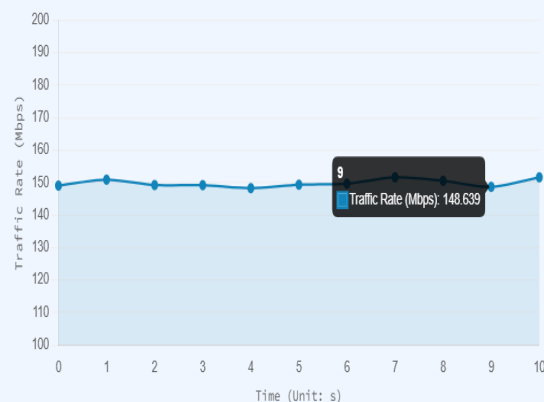
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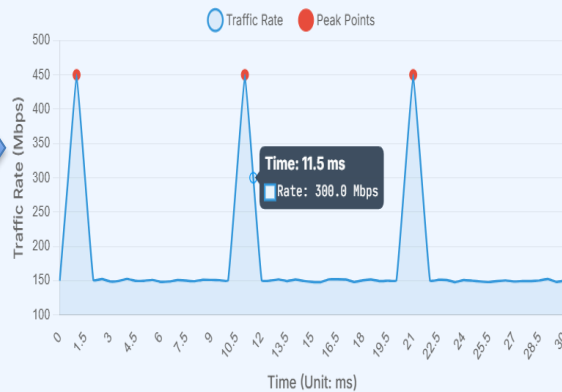
“Why Our Network Drops Packets Even When ‘Avg Utilization’ Is Low — The Microburst Truth”

? What is Microburst?

A transient traffic spike causing packet drops — even when avg utilization looks low.



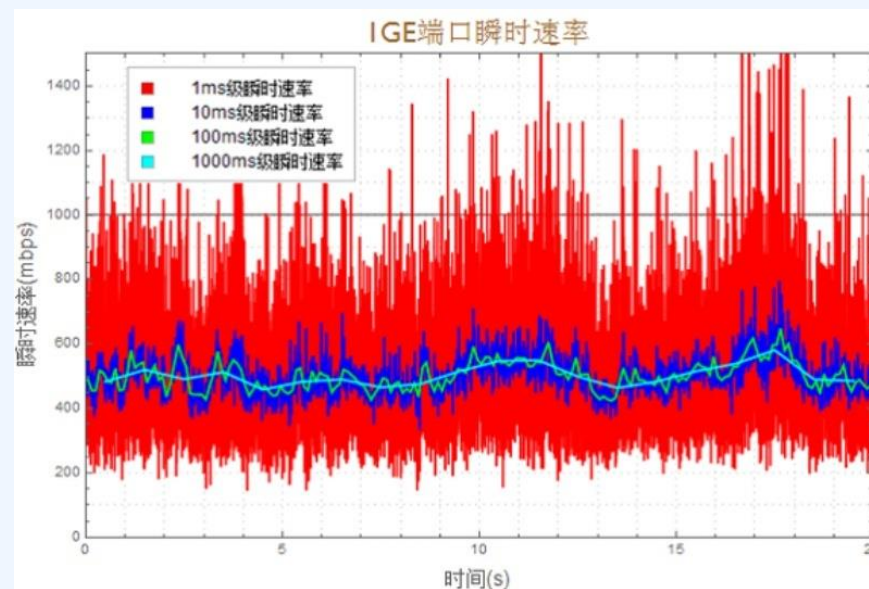
Steady-State Performance Overview



High-Frequency Periodic Fluctuations

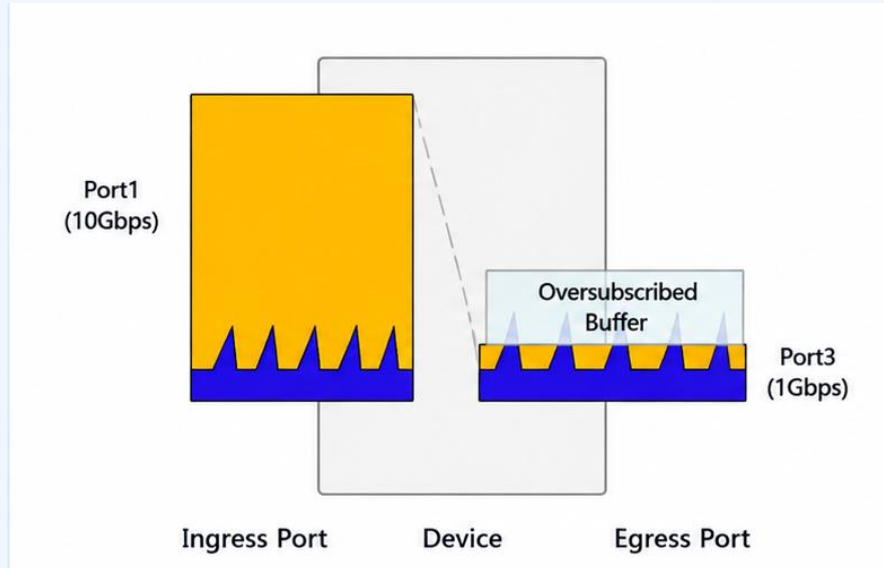
📄 RFC 8238: “Packet drops occur without sustained congestion burst is unevenly distributed over time $T < C$.”

📊 Real Network Data: China Unicom



Peak millisecond traffic = **400%** of average
(Measured over 300s stats period — hidden by averaging)

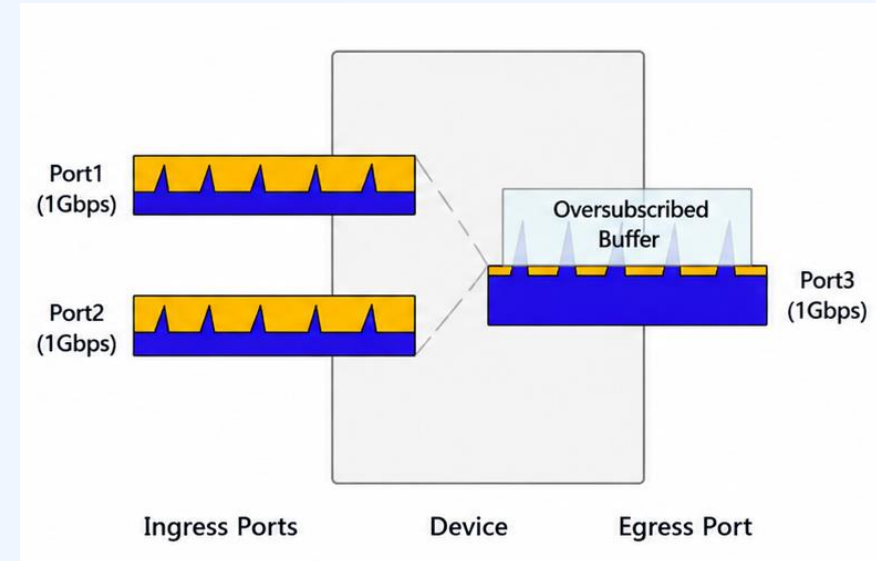
How Microbursts Are Generated — And Whether They Follow Predictable Patterns



High-speed ingress port sending traffic to a low-speed egress port

Microbursts cause by two core scenarios:

- Speed mismatch (e.g., 10G → 1G)
- Multi-port convergence (e.g., 2×1G → 1G)



Multiple ingress ports feeding one egress port

Root causes:

- Excessive oversubscription/ Suboptimal traffic path planning
- Inadequate buffer sizing

From Blind Spots to Centralized Visibility: Extending IGP & BGP-LS with Microburst Metrics

1. The Problem: Existing TE Metrics Are Blind to Microbursts

- Coarse-grained stats (delay/loss/utilization) average over seconds/minutes — **miss millisecond-level traffic spikes**.
- Active probing (TWAMP/STAMP) cannot scale to ms precision — exponential overhead, self-inflicted bandwidth and potentially causing congestion itself.

2. The Opportunity: Hardware Now Enables In-Network Precision Monitoring

- Modern ASIC/NPUs can monitor port queues, microburst counts at **sub-millisecond granularity** — **without adding probe traffic**.
- This is not just “better telemetry” — it’s a **paradigm shift from estimation to observation**.

3. Extend IGP & BGP-LS with Microburst Metrics

- Advertise real-time microburst indicators (e.g., burst count, drop rate, queue depth, interval) via IS-IS LSPs — enabling intra-domain visibility.
- Propagate these metrics via BGP-LS to SDN controllers/PCEs — enabling **centralized visualization** and proactive control.

4. Why This Matters: Beyond Loss — Quantify Jitter & Buffer Risk

- Microbursts don’t always cause drops — but they will affect **jitter and latency** via buffer buildup.
- These metrics expose both loss AND latency risk — critical for DetNet, AR/VR, financial trading.

Microburst-Aware Path and Traffic Optimization

1. Risk Advertisement

Network nodes advertise link-level microburst metrics through IGP extensions, enabling early identification of high-risk links—even when average utilization is low.

2. Global Data Collection

BGP-LS collects the underlay topology and microburst metrics into the controller's Traffic Engineering Databases (TED), providing a unified network-wide view with risk visualization.

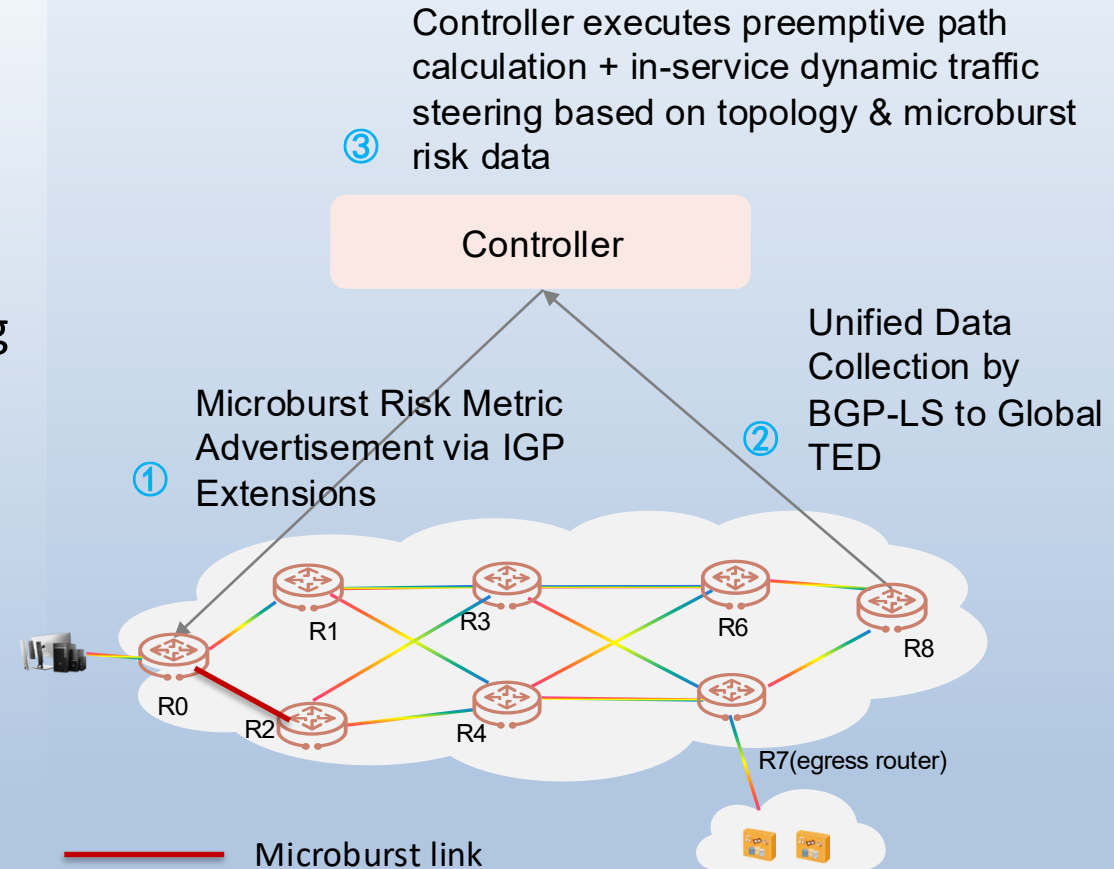
3. Dynamic Traffic Optimization

The PCE/SDN controller combines bandwidth utilization and microburst indicators to make traffic-engineering decisions:

- Moderate utilization without microbursts: No traffic steering.
- Persistent microburst loss: Reroute selected traffic over an alternative SRv6 path or apply targeted rate limiting.

4. Long-Term Optimization

Historical microburst data helps operators optimize device buffers, improve traffic pacing, and plan targeted capacity upgrades.



Microburst Metrics: Use Cases & Operational Benefits

 Distributing Microburst Metrics via IGP/BGP-LS provides operators with **fine-grained network visibility**, enabling the following operational benefits

Proactive Risk Visualization

- **Historical Burst Profiling:** Continuously recording microburst events across the network to map burst-prone links and identify periodic patterns (e.g., peak/off-peak hour correlations).
- **Hidden Threat Warning:** Correlating microburst data with steady-state metrics to isolate links with healthy average utilization but hidden localized congestion, enabling mitigation before SLA drops.

Real-Time Traffic Engineering

- **Dynamic Path Adjustment:** Steering latency-sensitive services away from high-frequency microburst links.
- **BE Traffic Throttling:** Temporarily pausing or throttling background traffic on affected links to mitigate congestion without over-provisioning.

Network Planning & Device Tuning

- **Buffer Optimization:** Using Max/Average Queue Occupancy data to dynamically tune buffer thresholds on specific vulnerable ports.
- **Capacity Expansion Planning:** Replacing blind over-provisioning with precise, data-driven physical link upgrades based on long-term microburst trends

Proposed Solution - Microburst Metrics Extensions

To bridge the detection gap, we propose extensions to IS-IS, OSPF, and BGP-LS to advertise aggregated Microburst Metrics. The design adheres to the following principles:

- ① **Aggregated Advertisement:** Statistics are aggregated over a measurement interval. Individual microburst events are NOT advertised per-event, preventing excessive IGP flooding.
- ② **Per-Traffic-Class (Per-TC) Visibility:** Metrics are bound to a specific TC (Traffic Class), as microbursts are queue-isolated and affect different classes independently.
- ③ **Multi-Dimensional Metrics:** Provides a holistic assessment of transient risks by combining event counts, drop statistics, and queue-occupancy depths. This multi-dimensional view allows operators to evaluate not only packet loss caused by buffer overflow, but also latency and jitter variations induced by instantaneous buffer buildup—even when no drops occur.

Field	Octets	Description
A bit & Reserved	1	Anomaly flag for threshold crossing
TC	1	Traffic Class identifier
Measurement Interval	2	Aggregation period (in seconds)
Total Microburst Count	4	Number of detected bursts
Microbursts Loss Count	4	Bursts causing packet drops
Max Drops per Microburst	4	Worst-case drop in a single burst
Total Burst Drop Count	4	Total drops during bursts
Max Queue Occupancy	4	Peak queue depth (in octets)
Average Queue Occupancy	4	Mean queue depth over interval

IS-IS & OSPF Extensions: Microburst Metrics TLV Structure

Next Steps

- Ask for more reviews and comments from the LSR WG.
- Welcome interested individuals and operators to join us in future revisions.

THANKS!

If you are interested in draft or have suggestions on how we can enhance our draft. Please contact us!
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