Use of Sketches in DPP for DDoS and Monitoring

Data plane real-time analytics for the network visibility

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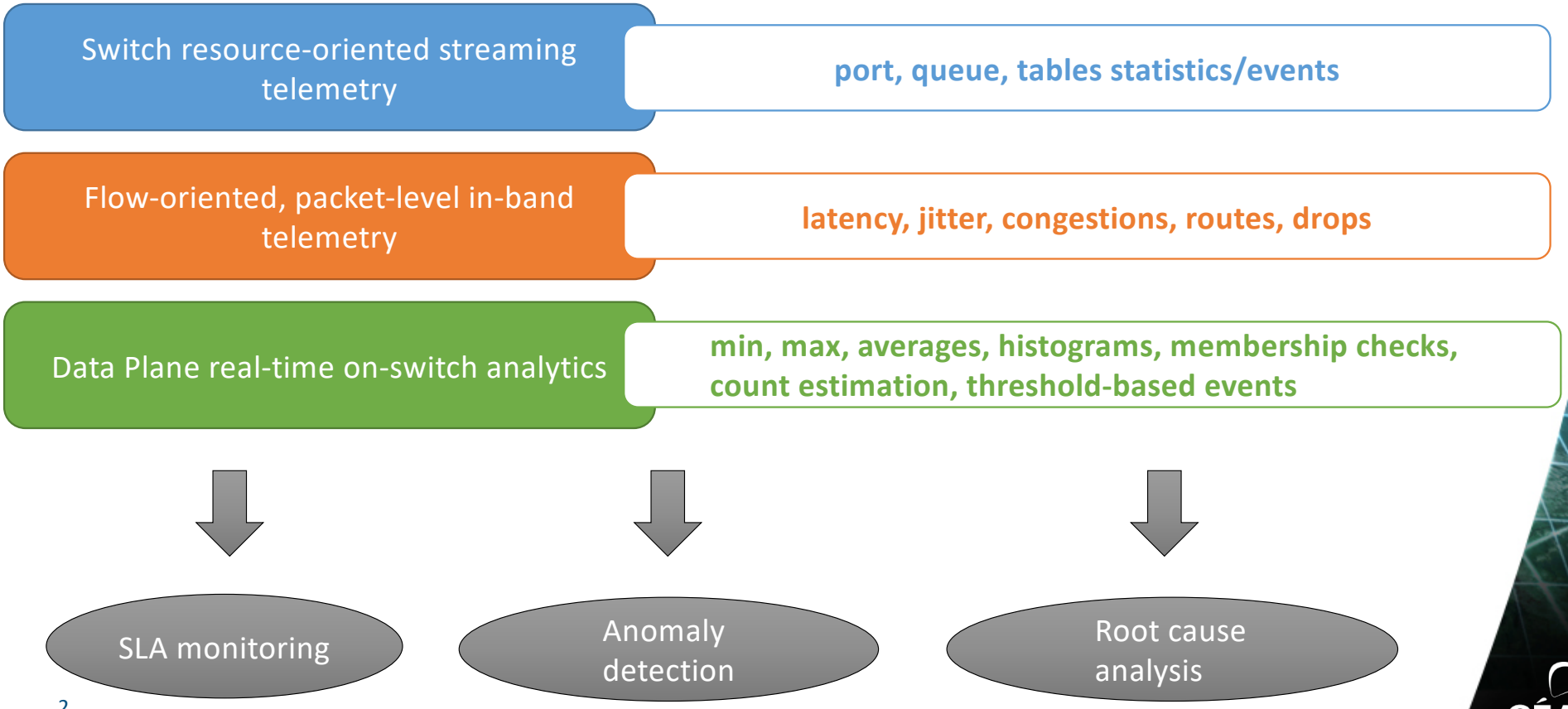
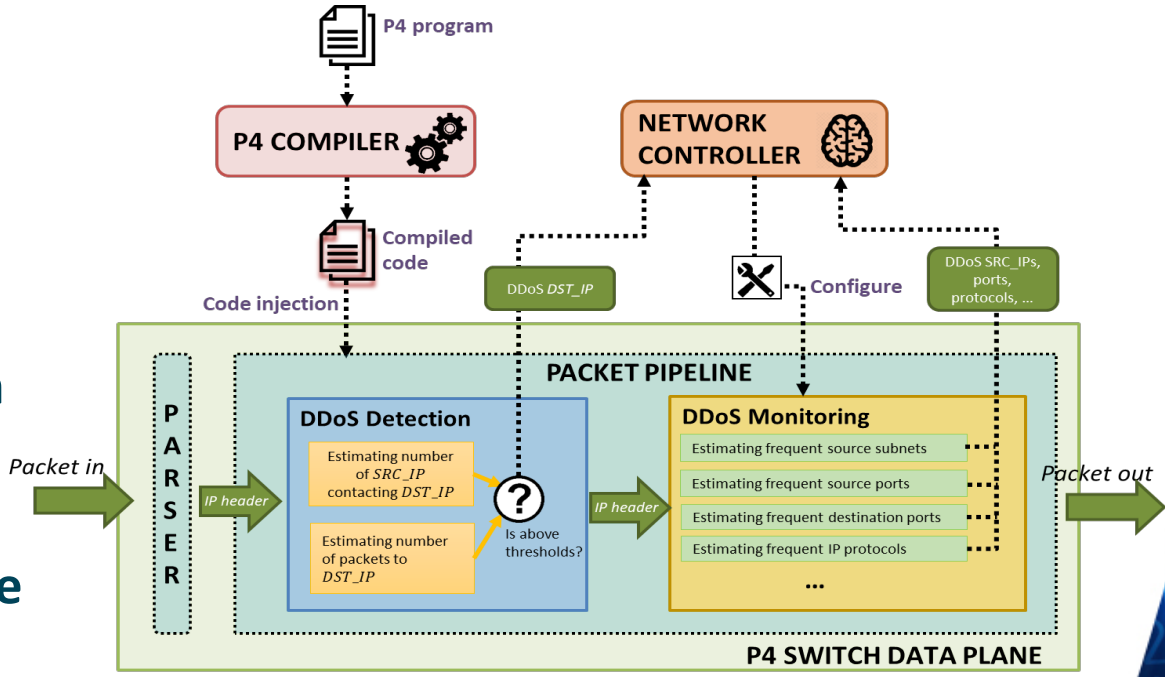
Evolution and complementarity in the network monitoring

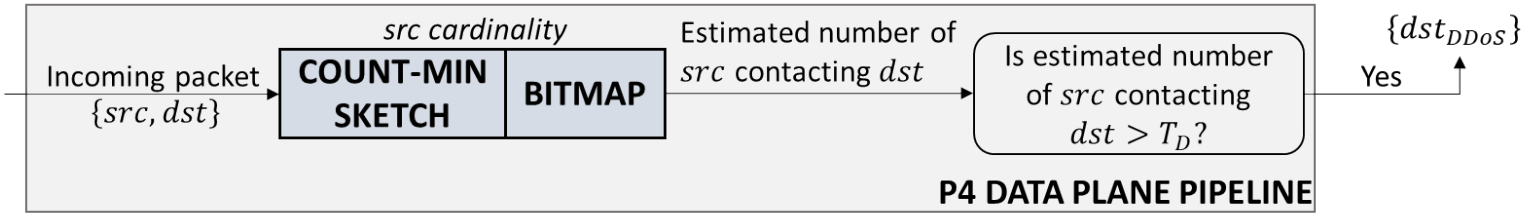


Analytics in Data Plane for simple DDoS detection and DDoS traffic monitoring

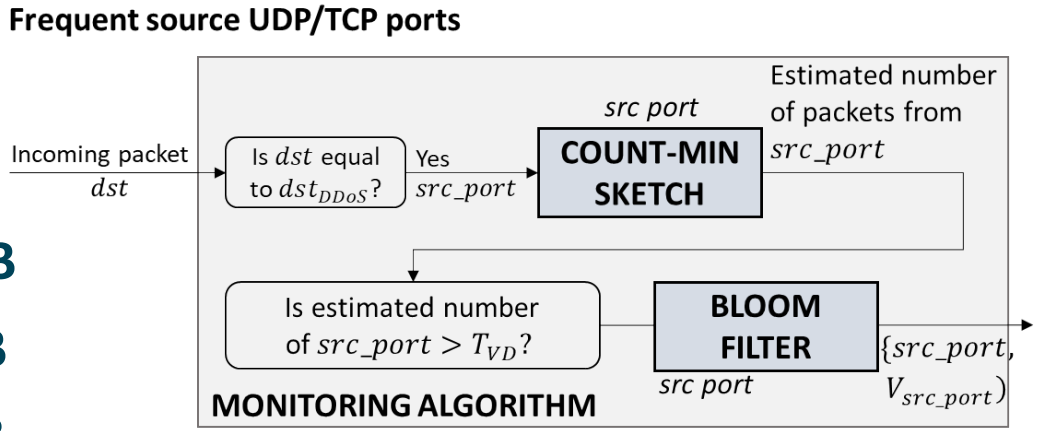
- Very fast detection (< 1sec) based on thresholds of IP destinations in packets
- Measured at boundaries of NRENs/ GÉANT network
- Providing detailed information about the DDoS attack characteristics
- Possibility of almost immediate mitigation of the attack
- About 400-800 KB of switch memory required



Sketch structures used in our P4 anti-DDoS algorithms

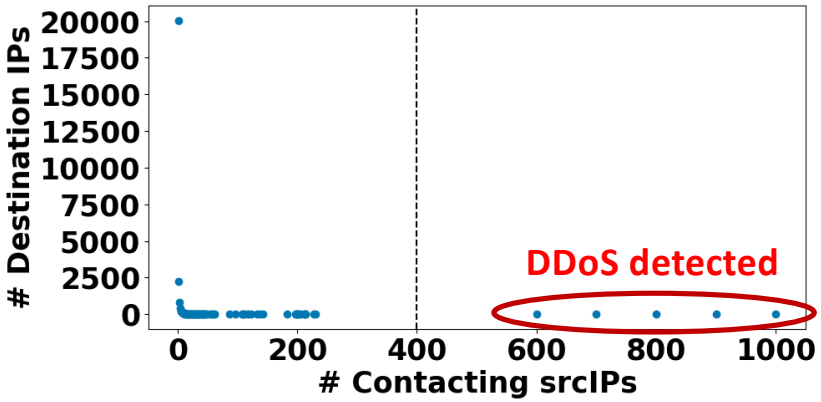


- **Sketch-based strategy for volumetric DDoS attack detection**
- **IPv4 cardinality sketch: 400 KB**
- **port frequency sketch: 34.6KB**
- **port membership sketch: 1.08 KB**



Accuracy tests and performance tests

Synthetic traffic *(with simulated DDoS)*



- Tested with CAIDA UCSD Anonymized Internet Traces Dataset + simulated DDoS traffic
  - ~491K packets, ~28K flows per a second

- 10G performance tests with iperf generated traffic
  - Testbed limitations visible

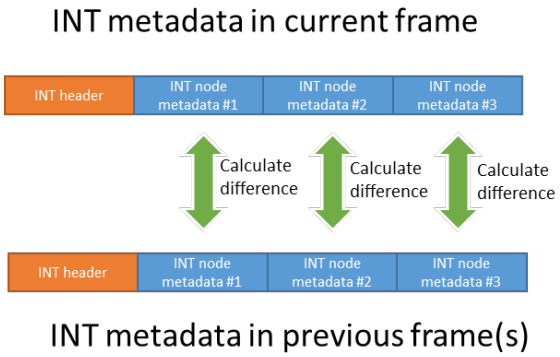
iPerf bandwidth: **10 Gbps**

L4 Protocol	Datagram/ Segment size	Packet loss (No loss)	Throughput (Bottleneck: CPU server)	Average Packet processing time
UDP	500 bytes	0%	1.03 Gbps	393 ns
UDP	1000 bytes	0%	1.95 Gbps	390 ns
UDP	1470 bytes	0%	2.87 Gbps	389 ns
UDP	3000 bytes	0%	5.45 Gbps	396 ns
UDP	6000 bytes	0%	9.62 Gbps	392 ns
UDP	9000 bytes	0%	9.67 Gbps	392 ns
TCP	64 Kbytes	-	9.05 Gbps	392 ns
TCP	128 Kbytes	-	9.41 Gbps	389 ns

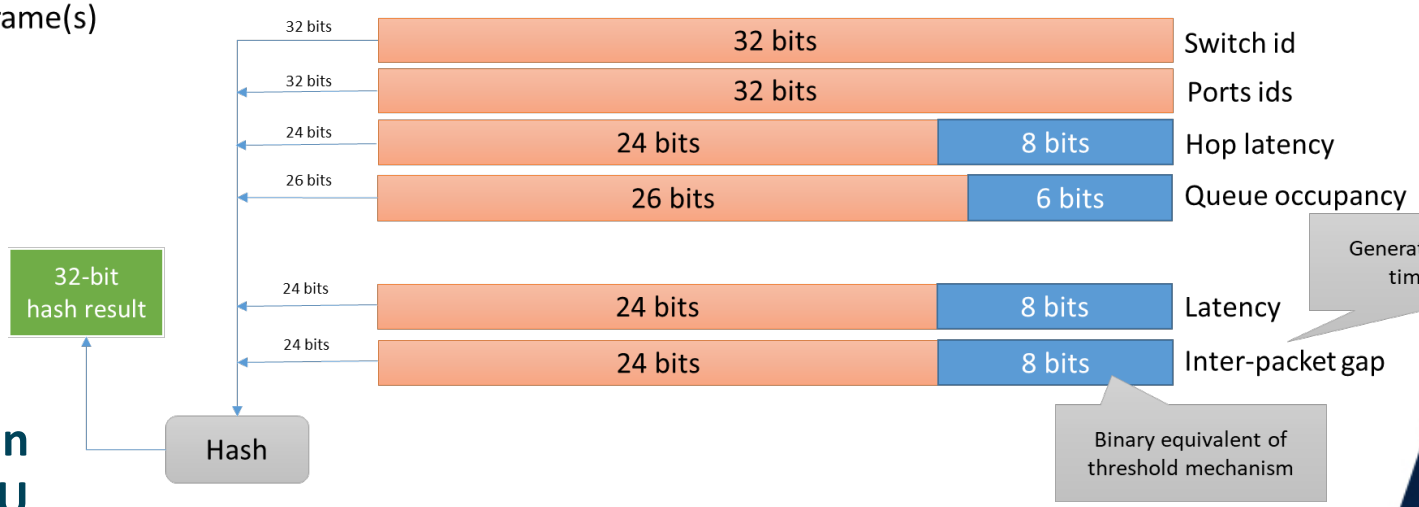
Data plane sketches drawbacks/problems

- Requires proper pre-configuration to be effective
  - Sketch parameters have a large impact on the quality of their estimations
- A sketch instance is a single purpose entity
  - For multiple concurrent data plane analytics more sketches are required
- Lack of resources for additional data plane analytics in current Barefoot Tofino based switches
  - Available packet pipeline processing stages fully utilized for switching functionalities and currently implemented sketches
- More complex sketches not possible in P4
  - Limited resources to implement very complex packet processing
  - Lack of arithmetic operations such as division or logaritmic operations requires creative solutions

Data plane INT analytics (not sketch-based)



- **Divide INT metadata fields into two parts:**
  - **bits which should be constant for some time**
  - **bits which may change without triggering a new INT report**



Hash operation can save a lot of ALU operations

Conclusions

- Data Plane programming is now available to "users" and will enrich our monitoring toolset
- No single silver bullet for network visibility
  - Focus on „information that matters” because switch resources are scarce and Big Data infrastructure is costly

- Data Plane real-time analytics can be used for:
  - Generating global and scalable accurate statistics
  - Detecting outliers and reacting in near real-time
  - Complementing switch’s other telemetry capabilities
  - Data Plane processing may greatly reduce requirements on the network analytics infrastructure

Thank you

Any questions?

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