

Performance Prediction of On-NIC Network Functions with Multi-Resource Contention and Traffic Awareness

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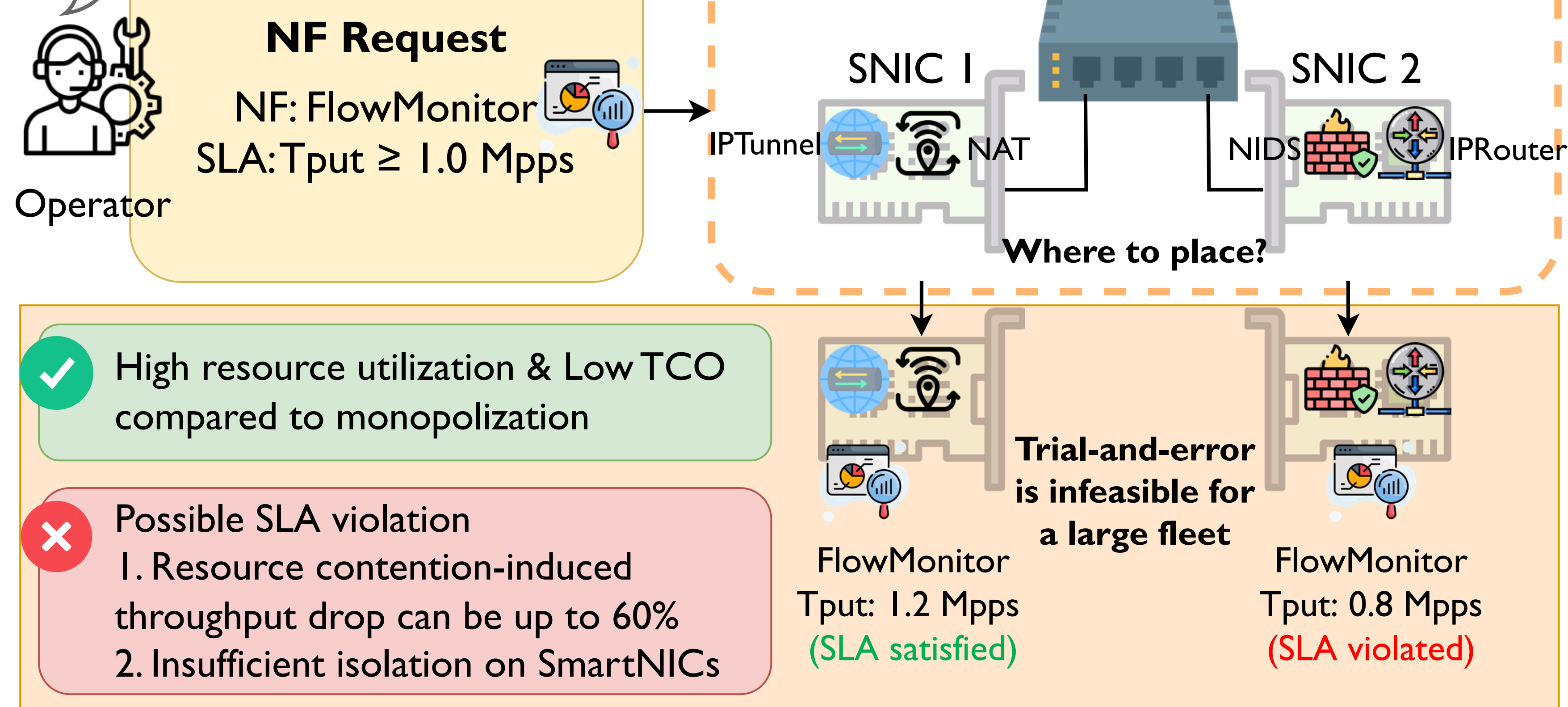
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Problem

- How to predict NF performance under resource contention?

Goal:

1. Minimize SLA violation
2. Maximize co-locations



Contention-Aware Scheduling:

Placing NFs based on contention-aware performance predictions

- Avoid SLA violation despite resource contention

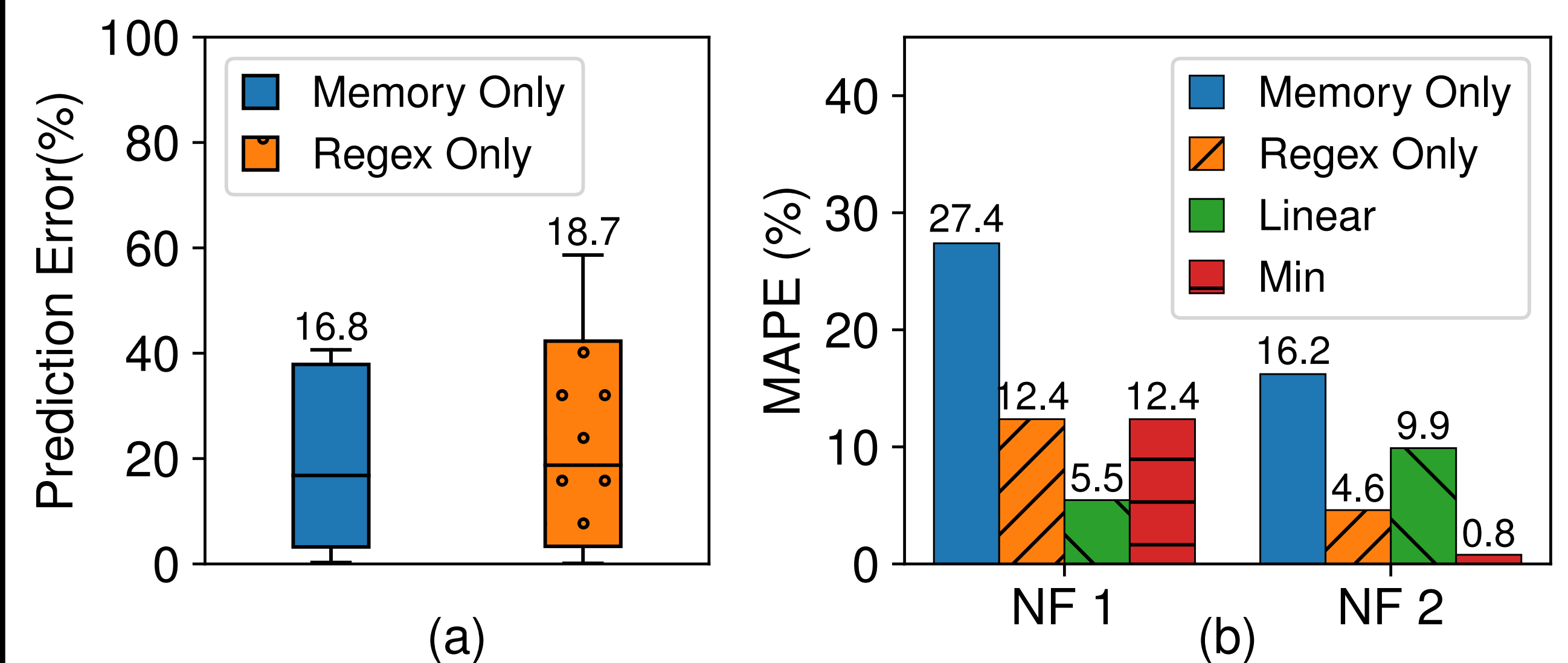
$$f(\text{FlowMonitor}) = 1.3 \text{ Mpps}$$

$$f(\text{FlowMonitor}) = 0.7 \text{ Mpps}$$

- Our contribution: accurate performance prediction of on-NIC NFs under multi-resource contention and varying traffic attributes

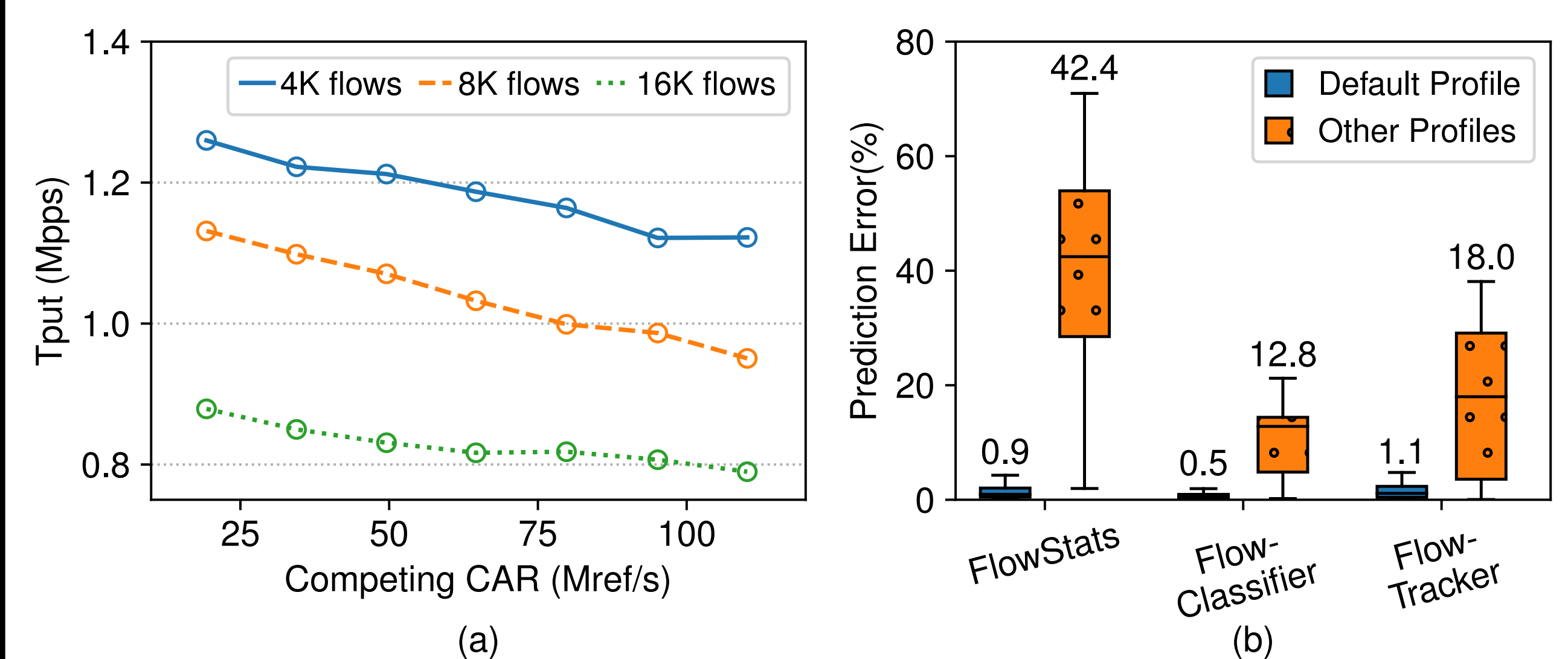
C1. Multi-Resource Contention

- On-NIC NFs contend over multiple heterogeneous onboard resources



C2. Varying Traffic Attributes

- NF performance depends on certain traffic attributes



Evaluation

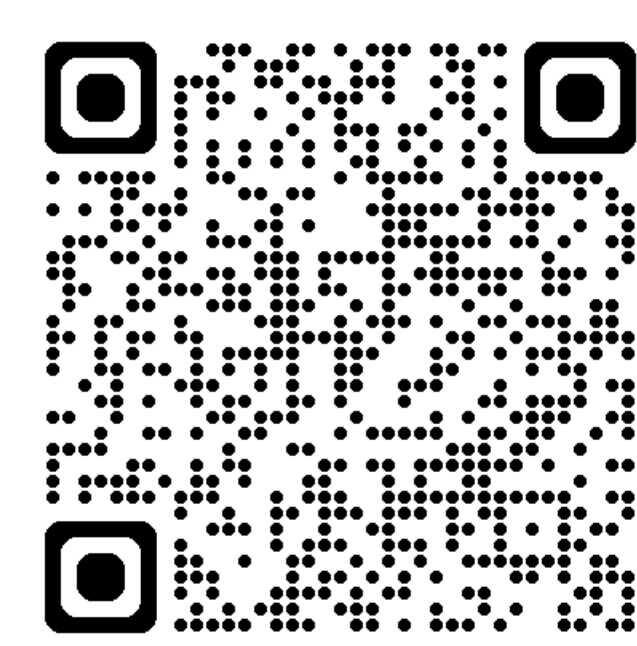
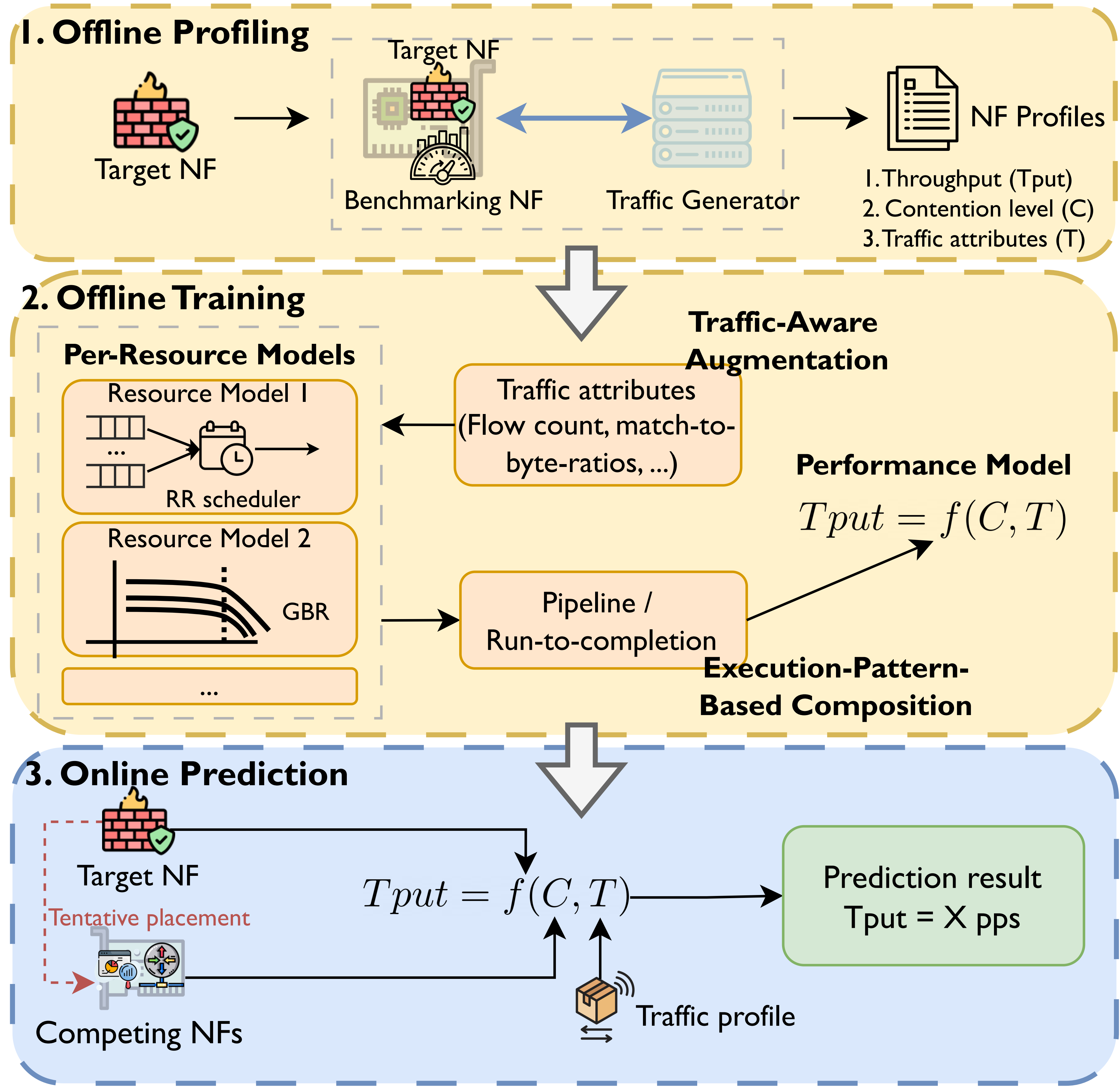
- 3.7% prediction error & 78.8% accuracy improvement

NF	SLOMO			Yala		
	MAPE (%)	±5% Acc.(%)	±10% Acc.(%)	MAPE (%) ↓	±5% Acc.(%) ↑	±10% Acc.(%) ↑
ACL	1.3	100.0	100.0	1.2	100.0	100.0
NIDS	16.2	24.3	74.3	1.5	95.9	100.0
IPTunnel	62.9	70.5	73.1	3.8	75.6	92.3
IPRouter	4.2	68.4	98.2	3.8	66.7	100.0
FlowClassifier	7.5	28.1	73.7	3.8	63.2	100.0
FlowTracker	4.9	56.1	86.0	3.9	61.4	100.0
FlowStats	11.7	33.3	57.9	4.3	70.2	96.5
FlowMonitor	40.9	31.1	41.9	4.5	62.2	93.2
NAT	8.2	38.6	49.1	6.4	42.1	80.7

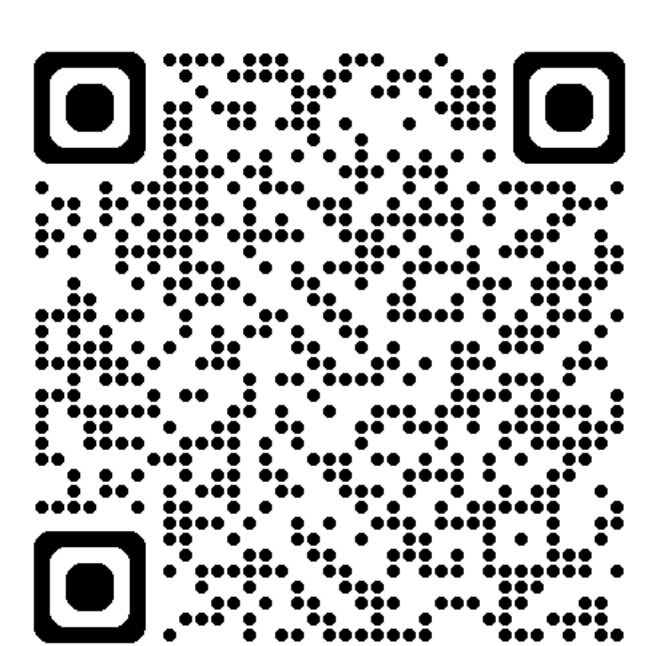
- Resource-efficient scheduling of on-NIC NFs, SLA violations reduced by 92.2%

Approach	Resource Wastage (%)	SLA Violations (%)
Monopolization	196.3	0
Greedy	19.0	16.5
SLOMO	-21.8	24.4
Yala	0.5	1.9

Design Overview



Paper



Github