Towards Trustworthy Telemetry and QoE Measurements

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Network Telemetry

Collect and analyze measurements to understand what is happening in the network for operation and management.

Examples:
- What are the largest flows in the current network?
- Are there any flows with high packet loss?
- Is there an ongoing SYN flood attack?
- What is the network latency of my application?
Network Devices

- Heavy hitter detection
- Performance estimation
- Security analysis

Network Traffic

Telemetry algorithms

A Typical Network Operator
Example Scenario: Performance Analysis

Troubleshooting and fixes

What’s happening?

- Packet drop
- Latency
- Bandwidth

Poor Performance
“The Problem of Trust”

Network Operator

Telemetry Methods

Network Devices

Network Traffic
Threat Model 1: Untrusted Operators

If operators can prove their network QoS, ....
Why Need Operators to Prove?

End-to-end QoE measurements can be dominated by wide-area Internet performance variations.
Trustworthy measurement enables new opportunities

Promoted services, split billing, etc.
Threat Model 2: Untrusted Network Devices

Cisco warns of critical switch bugs with public exploit code

Gain unfair performance advantages, billing benefits, etc.
Threat Model 3: Algorithmic Vulnerabilities

ON THE ROBUSTNESS OF COUNTSKETCH TO ADAPTIVE INPUTS

How Robust are Linear Sketches to Adaptive Inputs?

Moritz Hardt, David P. Woodruff

Need algorithmic improvements for network workloads
Vision: Trustworthy telemetry and QoE measurement

Attacker

Forge the results
Adversarial workloads

Operator

Did I get the correct result?
Can I verify the result?

Content Provider

Did I get the correct result?
Can I verify the result?
What we can do?

**Hardware roots of trust**
- Trusted Execution Environment (TEE)
- Trusted Platform Module (TPM)

**Cryptographic tools**
- Interactive proofs and zero-knowledge
- Non-interactive proofs
- Confidential computing

**Algorithmic tools**
- Robust sketching algorithms
- Verification tools

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