# Autonomic Networking Use Case for Distributed Detection of SLA Violations

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# Outline


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# Introduction

- Critical networked services expected to operate respecting associated Service Level Agreements (SLAs)
  - To ensure that SLAs are not being violated $\rightarrow$ constantly monitoring of service levels at the network layer
- Active measurement mechanisms
  - Better accuracy and privacy than passive ones
  - Detection of end-to-end network performance problems
- IP Performance Metrics (IPPM) WG Active mechanisms
  - One-Way Active Measurement Protocol (OWAMP) [RFC4656]
  - Two-Way Active Measurement Protocol (TWAMP) [RFC5357]
  - Cisco Service Level Assurance Protocol (SLA) [RFC6812]
- Measurement probes distributed along the network to inject synthetic traffic and deliver the SLA metrics

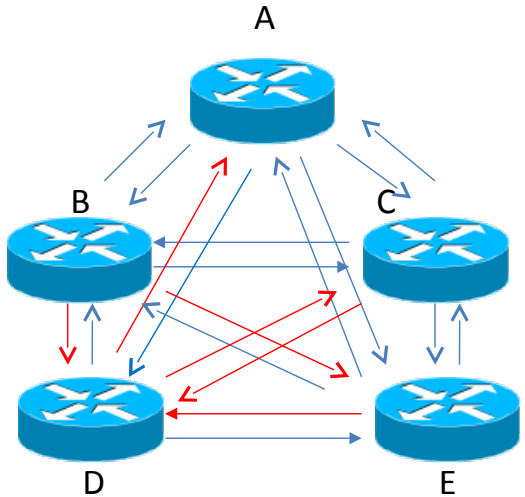
# Problem Statement

- Activation of active measurement probes $\rightarrow$ expensive in terms of resource consumption
- Required resources $\rightarrow$ function of the # of measured destinations
- Better monitoring coverage $\rightarrow$ more probes
  - Monitor all connections is too expensive $\rightarrow$ combinatorial explosion
  - Fast reactions required to reconfigure probes if critical flows are too short in time and dynamic in terms of traversing network paths

# Problem Statement

## Best practice

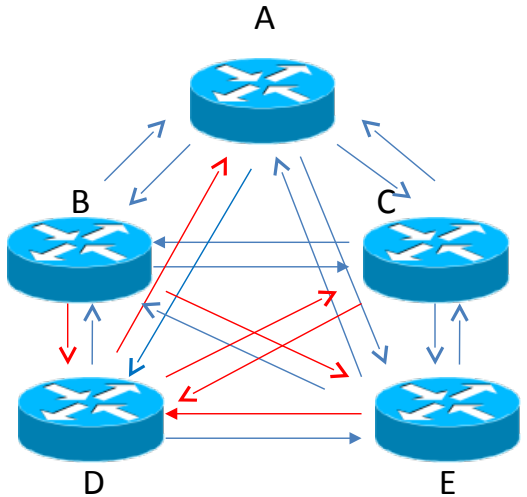
- Distribution of the available measurement probes along the network considering human administrator expertise
- Collection of measurement and traffic information to infer which are the best locations to activate probes




| | A | B | C | D | E |
|---|---|---|---|---|---|
| A | | 5 | 6 | 4 | 7 |
| B | 5 | | 7 | 12 | 10 |
| C | 6 | 7 | | 13 | 7 |
| D | 15 | 12 | 13 | | 8 |
| E | 1 | 3 | 5 | 14 | |

# Problem Statement

- Too difficult and labor intensive
- Inefficient considering fast changing network environments
- # of detections constrained by the # of available probes

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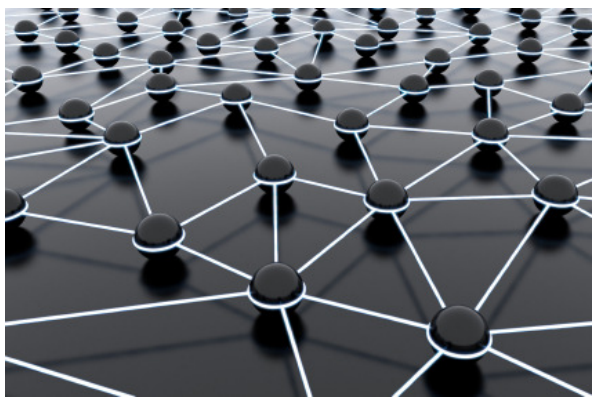
# Problem Statement

- Embedded management SW $\rightarrow$ deployment control of active measurement mechanisms
  - Network device vendors $\rightarrow$ utilization to avoid devices starvation (e.g., due to configuration errors and lack of experience from human administrators)
- Lack of enhancements in scalability and efficiency
- Resources and knowledge about the network infrastructure not shared by network devices



# Benefits of an Autonomic Solution

- Goal $\rightarrow$ complete solution to steer the process of measurement probe activation
- Settings of necessary parameters for this activation
  - Efficiently
  - Reliably
  - securely
  - Minimal human intervention
- Autonomic solution should include and/or reference specific algorithms, protocols, metrics and technologies for the implementation of measurement probe activation

# Benefits of an Autonomic Solution

## Features

1. Optimization of resource consumption and avoidance of resource starvation on the network devices
   - Better efficiency in the probe activation decisions
   - Sharing of measurement results
2. Increase on the # of detected SLA violations
   - Better network coverage
3. Decrease on the time necessary to detect SLA violations
   - Adaptivity features of an autonomic loop $\rightarrow$ capturing network dynamics faster than an human administrator
4. Reduction on the workload of human administrators
   - At least to avoid their need to perform operational tasks

# Intended User and Administrator Experience

- AN solution $\rightarrow$ to avoid the human intervention in the distributed detection of SLA violations
- SLA monitoring performed by less experienced human administrators
- Some information necessary from the human administrator
  - E.g., SLOs (regarding the SLA being monitored) provided by the human administrator
- Configuration and bootstrapping of network devices $\rightarrow$ minimal for the human administrator
  - E.g., information about the address of a solution-enabled device
  - Exchange of configuration data among the devices themselves

# Analysis of Parameters and Information Involved

## Device Based Self-Knowledge and Decision

- Each device $\rightarrow$ self-knowledge about local SLA monitoring
  - E.g., SLOs, historical measurement data
- AN decision on devices about the probe activation algorithm

## Interaction with other devices

- Network devices $\rightarrow$ info sharing about SL results
  - Increase the # of detected SLA violations and their speed
- Definition of network devices that exchange measurement data $\rightarrow$ creation of a new topology
- Different approaches for topology definition
  - E.g., correlated peers (local relevancy of remote results)
  - Bootstrapping $\rightarrow$ known endpoints neighbours as initial seed

# Comparison with current solutions

- No standardized solution for distributed autonomic detection of SLA violations
- Current solutions usually restricted to ad hoc scripts running on a per node fashion to automate some administrator's actions
- Some proposals for passive probe activation (e.g., DECON and CSAMP), but without the focus on autonomic features
- Barford *et al.* (INFOCOM 2009) $\rightarrow$ Detection and localization of links which cause anomalies along a network path
- Nobre *et al.* (CNSM 2012) $\rightarrow$ Utilization of P2P technology embedded in network devices to improve probe activation decisions using autonomic loops

# Related IETF Work

## Large-Scale Measurement of Broadband Performance (LMAP) WG

- AN solution relevant for LMAP $\rightarrow$ SLA violation screening
- Solution to decrease the workload of human administrators in service providers $\rightarrow$ probably highly desirable

## IP Flow Information Export (IPFIX) WG

- AN solution extension for passive measurement probes (i.e., metering exporters)
- Flow information used in the decision making of probe activation

## Application Layer Traffic Optimization (ALTO) Working Group

- Definition of the topology regarding the network devices which exchange measurement data

# Security Considerations

## Possible Approaches

- Bootstrapping of a new device → homenet approach [draft-behringer-homenet-trust-bootstrap]
- Measurement data exchange → signed and encrypted among devices
  - Sensible information about network infrastructures

## Possible Attacks

- Denial of service (DoS) attacks → activation of more local probe than the available resources allow
- Results could be forged by a device (attacker) in order to this device be considered peer of a specific device (target) → to gain information about a network infrastructure

# Outlook

## Revision 01

- IETF 91
- Minor text corrections
- Examples of SLA specifications

## Proposed solution I-D

- IETF 91
- AN P2P solution (architecture?)

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**Thanks for your attention! Questions?**