Internet Observation with N-TAP: how it works and what it does

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Outline

• Motivation and goal
• Design concepts and service model
• Architecture and implementation
• Performance, and so on...
Motivation: Measurement for Apps

• Autonomous applications have a demand for grasping the state of hosts and networks for:
  ‣ sustaining their services and networks
  ‣ scaling up their services and networks

• Measurement is now necessary for end nodes

• Problems on apps' measurement
  ‣ The measurement capability is limited
  ‣ Hurdle for the deployment of cooperative measurement
  ‣ Different apps may repeat the same implementation and measurement
Goal: The N-TAP Project

• Create an infrastructure with which:
  ‣ Applications can easily obtain network characteristics information
  ‣ Efficient measurement methodologies can be implemented for the collection of the information
Design Concepts

• Package measurement into a network service
  ‣ Any kind of applications can obtain network characteristics through the same interface

• Enhance the measurement capability of end nodes
  ‣ Implement efficient measurement methodologies
  ‣ End nodes can obtain several network characteristics that are difficult or impossible to be collected by only one end node
Overall Architecture

Measurement Plane cooperation among agents

Monitoring Agent

Application

End node

"Give me the IP topology among nodes A, B, C,..."

Requested information

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An application requests network characteristics to a monitoring agent

- Simple request/response service
- The messages are exchanged based on the XML-RPC protocol.

End Nodes and Monitoring Agents
• **Goal:** provide essential features for effective measurement
  ‣ Make the implementation of measurement methodologies easy

• **Cooperative measurement methodologies**
  ‣ Effective (e.g., rapid or low-load) collection of network characteristics through the interaction among monitoring agents
    - Share collected network characteristics
    - Control other monitoring nodes
  ‣ Examples: Vivaldi (RTT), Doubletree (IP topology)
Formation of a measurement overlay network

- Two agent's roles for stability: core and stub
- Chord-based peer-to-peer network among core agents
- Stub agents utilizes the features of the measurement plane via one of the core agents
Common APIs for implementors

- **Shared storage**
  - Store key-value pairs with the manner of DHT
    - Example: `key(RTT(from A to B)) = {hash(A), hash(B)}`

- **Communication channel among agents**
  - Store agents' information in the agents list in the shared storage
  - An agent can search other agents
    - "Is there any agent that can collect this kind of information?"

Caching

- for faster response
One Possible Deployment Scenario

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Implemented Methodologies

- **Simple ones**
  - ping, traceroute, avail. bandwidth (iperf), ...

- **Cooperative measurement**
  - DTS: Decentralized Tracing System
    - Doubletree on N-TAP
    - Quick discovery of full-mesh IP topology
  - Vivaldi-based RTT estimation
Performance Evaluation (summary)

• **Experiment on PlanetLab (128 core agents)**
  ‣ Storing in the shared database: ~ 1-2 sec.
    - Slow mainly due to some slower (high-loaded) nodes
  ‣ Core agents are important entities for performance

• **Experiment on StarBED (100 core agents)**
  ‣ Obtaining full-size RTT matrix (100x100) among the agents: < 500 msec.
    - No problem on performance in the ideal environment
    - Also good for monitoring the health of cluster nodes during an experiment on a test bed
Astrolabe

• Network characteristics visualizer on an end node

Connectivity Grid

Topology Viewer

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Open Issues

• Illegitimate usage of network measurement service
  ‣ Can the service be an attack traffic generator?

• Privacy?
  ‣ Some operators may not want to disclose the topology of their networks

• What kind of information should be provided to applications?
  ‣ Raw measurement data?
  ‣ Combined metric?
Conclusions

• N-TAP is a large-scale infrastructure with which:
  ‣ Cooperative measurement methodologies can be implemented
  ‣ Applications can obtain network characteristics information

• Application-oriented measurement platform

• Call for large-scale measurement methodologies implemented on N-TAP!
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