# 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

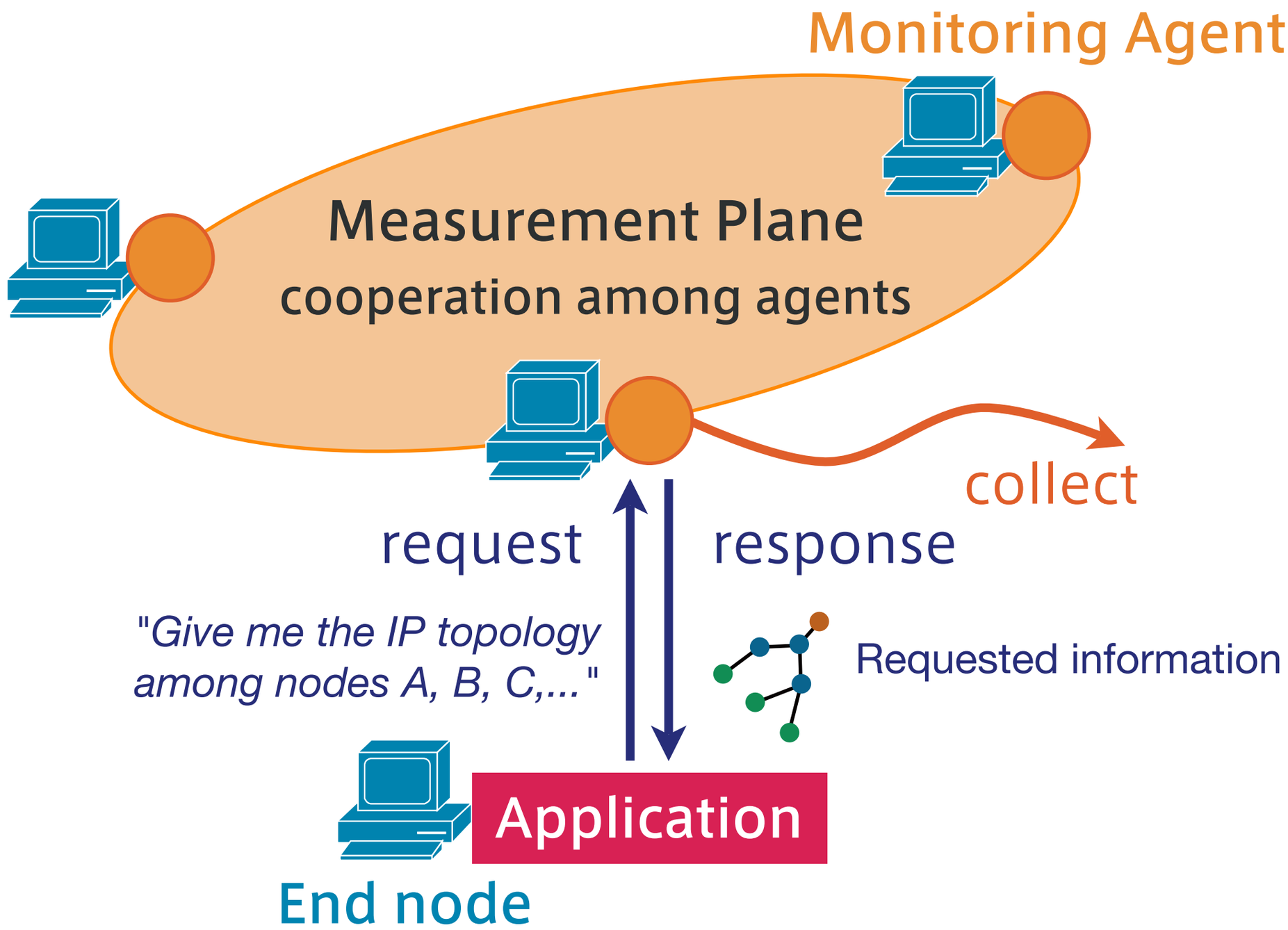
# Goal: The N-TAP Project

- **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

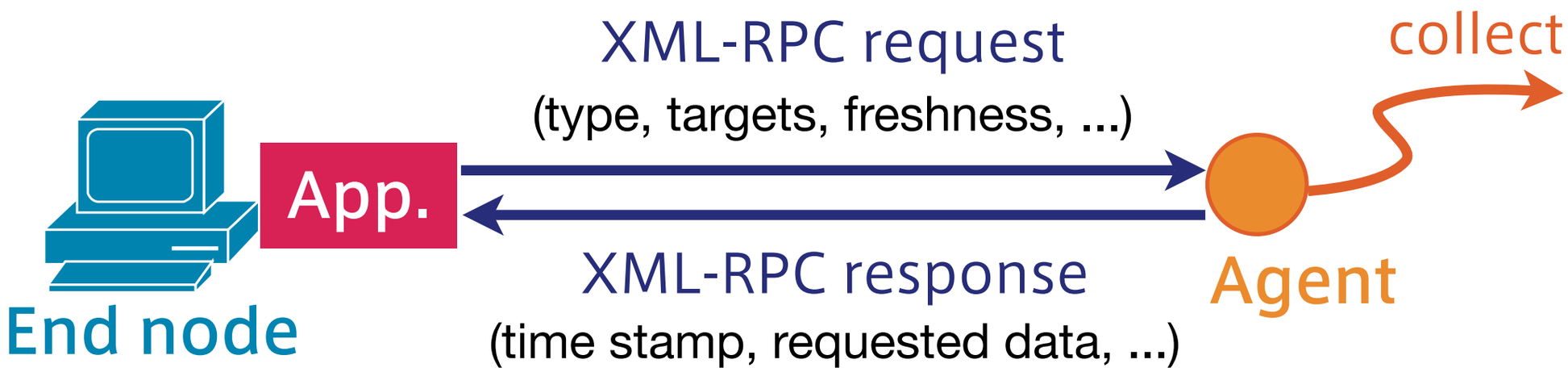
- **Package measurement into a network service**
  - Any kind of applications can obtain network characteristics through the same interface
- **Enhance the measurement capability of end nodes**
  - Implement efficient measurement methodologies
  - End nodes can obtain several network characteristics that are difficult or impossible to be collected by only one end node

# Overall Architecture



# End Nodes and Monitoring Agents

- **An application requests network characteristics to a monitoring agent**
  - Simple request/response service
  - The messages are exchanged based on the XML-RPC protocol.

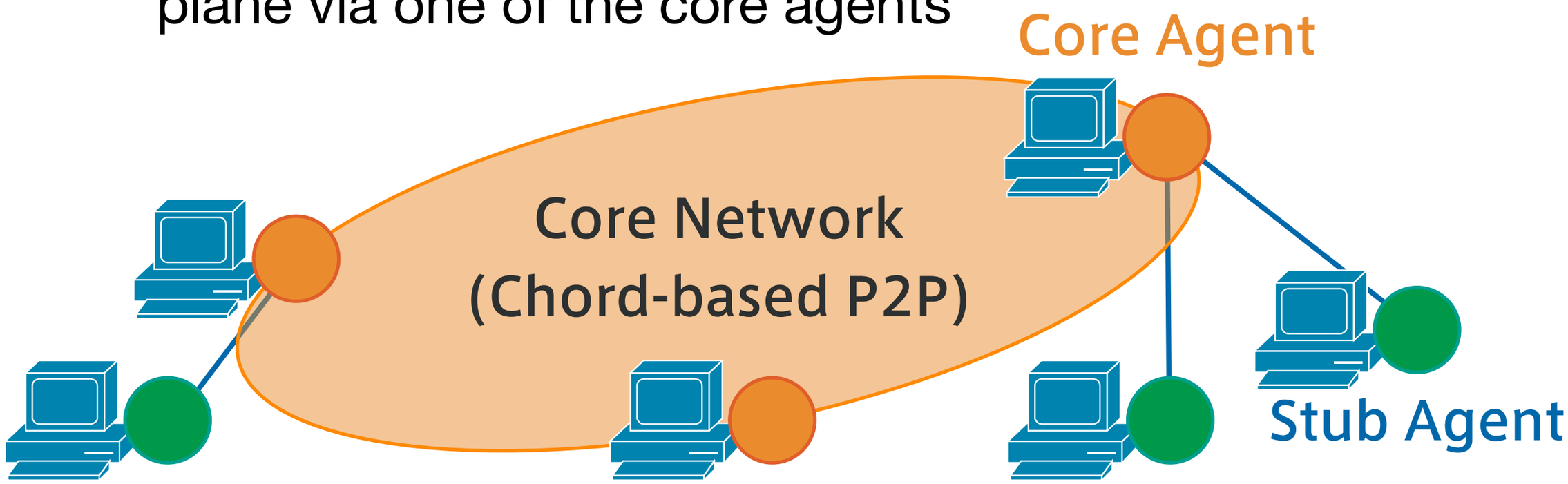


# Measurement Plane (1/3)

- **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)

# Measurement Plane (2/3)

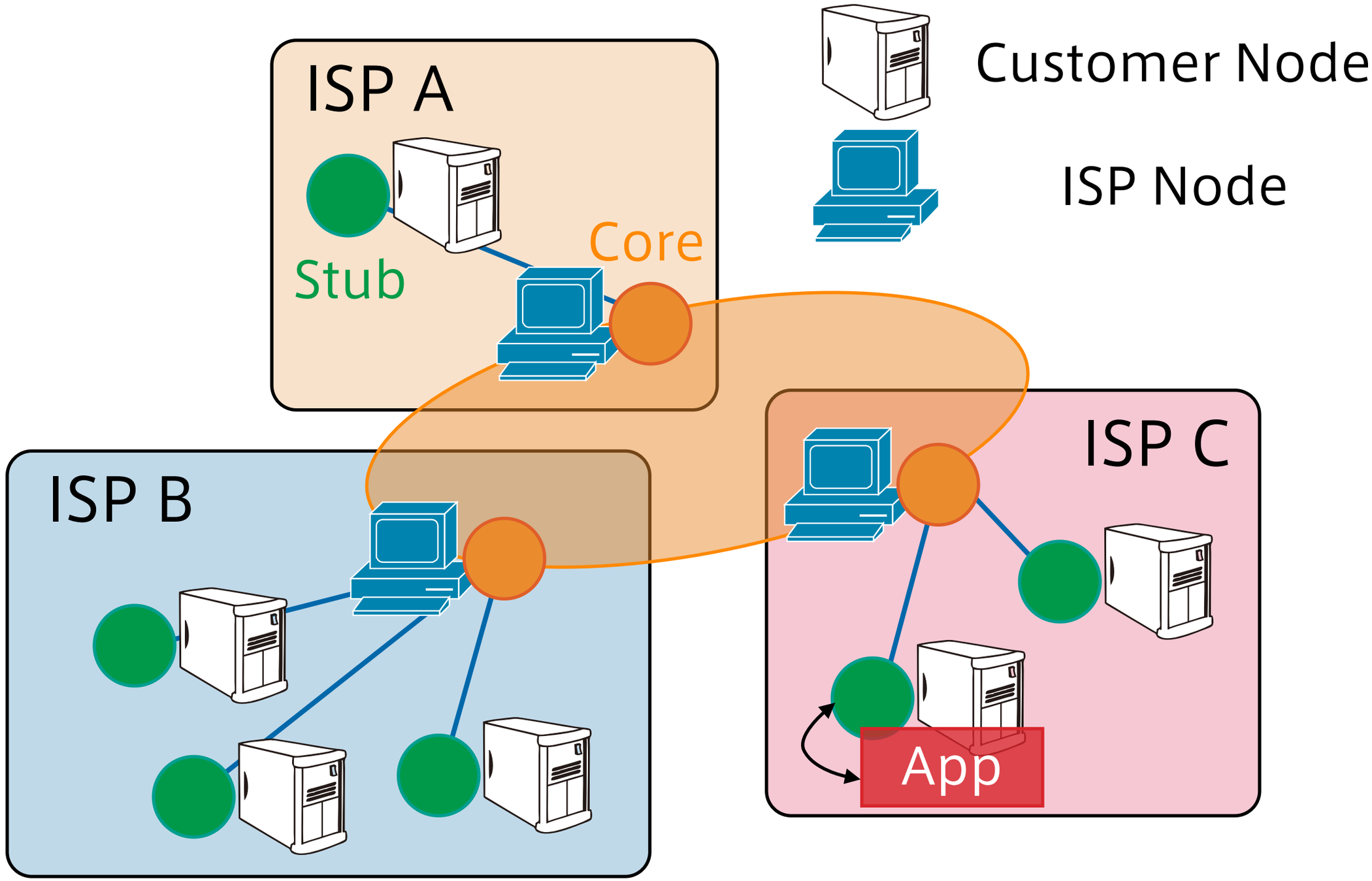
- **Formation of a measurement overlay network**
  - Two agent's roles for stability: *core* and *stub*
  - Chord-based peer-to-peer network among core agents
  - Stub agents utilizes the features of the measurement plane via one of the core agents



# Measurement Plane (3/3)

- **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



# 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)

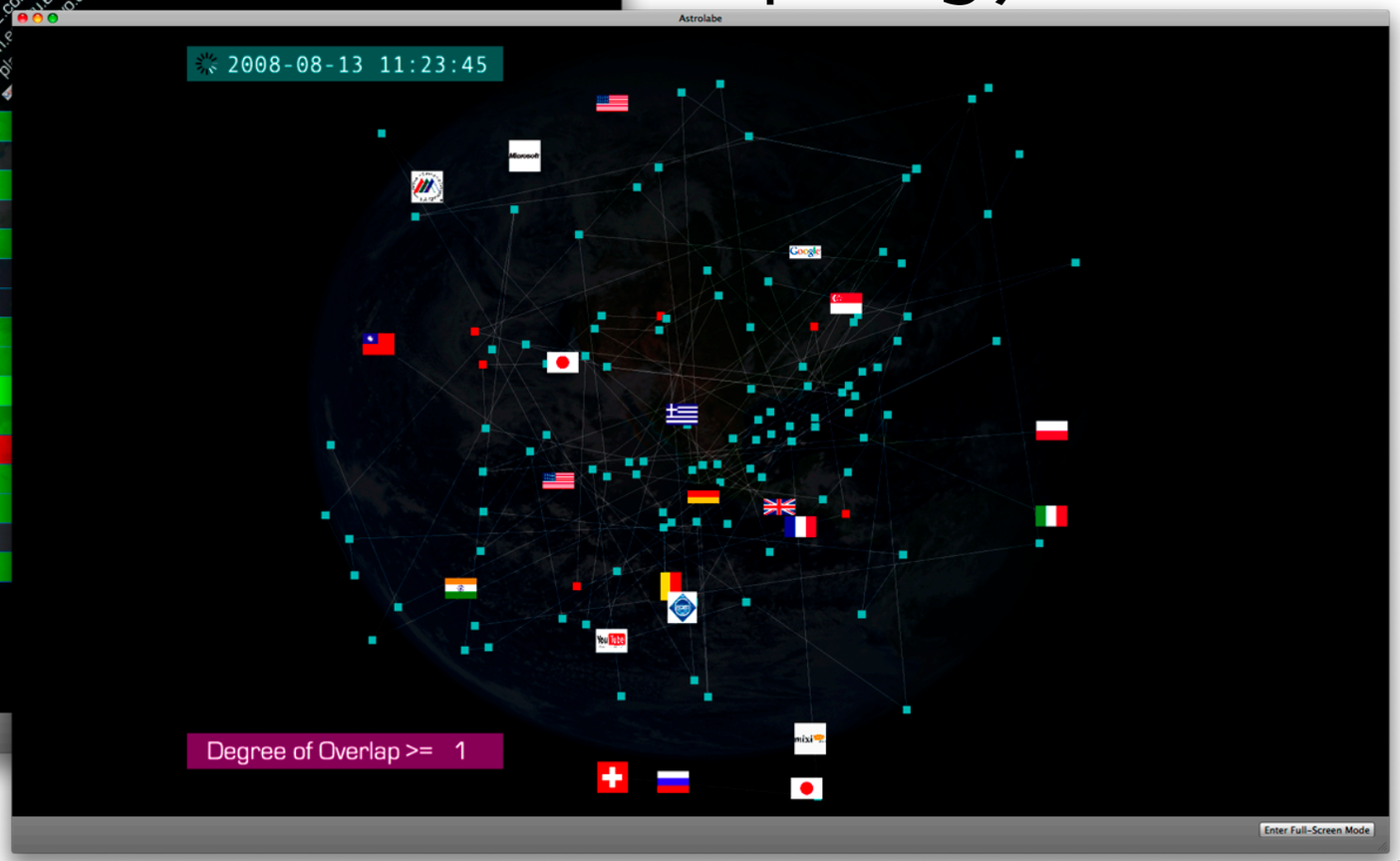
- **Experiment on PlanetLab (128 core agents)**
  - Storing in the shared database: ~ 1-2 sec.
    - Slow mainly due to some slower (high-loaded) nodes
  - Core agents are important entities for performance
- **Experiment on StarBED (100 core agents)**
  - Obtaining full-size RTT matrix (100x100) among 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



# 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!**

# Acknowledgements


- **This work was partly funded by the National Institute of Information and Communications Technology.**