VISUALIZING SOFTWARE DEFINED SWITCHING ON A STRUCTURED P2P OVERLAY TOPOLOGY USING BOUNDED FLOODING

PRAGMA36 DEMONSTRATION

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WELCOME

- THIS PROJECT FOCUSES ON NETWORK VIRTUALIZATION INFRASTRUCTURE THAT ALLOWS EDGE AND CLOUD RESOURCES TO BE DYNAMICALLY CONNECTED, USING NETWORK TUNNELS, INTO COMMUNITY VIRTUAL PRIVATE NETWORKS (VPNS).

MOTIVATION

- THE CONTEMPORARY DE-FACTO APPLICATION MODEL IS ONE USING MICROSERVICES WITHIN CONTAINERS.
  - DOCKER, LXD, KUBERNETES
- VIRTUAL NETWORKS ARE POSITIONED TO BE A VITAL COMPONENT OF THE SUCCESSFUL ORCHESTRATION AND INTEROPERABILITY OF CONTAINERIZED APPLICATIONS.
- HOWEVER, THERE ARE CHALLENGES THAT MUST BE ADDRESSED, PARTICULARLY AT THE NETWORK'S EDGE, TO REALIZE THE VISION OF UBIQUITOUS FOG COMPUTING.

METHOD

- USES IPOP TUNNELS FOR P2P DATA LINKS
  - SOFTWARE ABSTRACTION WHICH AGGREGATES A VIRTUAL NETWORK INTERFACE (TAP) AND A COMMUNICATION CHANNEL (WEB RTC)
- BUILDS A STRUCTURED RING TOPOLOGY
  - SUCCESSOR NODES ORDERED INCREASING CLOCKWISE BY UUID
- SYMPHONY LONG DISTANCE LINKS PROVIDE SHORTCUTS ACROSS RING
  - PEER SELECTION $e^{\mathrm{LOG}_{10} N \times (rand[0,1)-1)}$ Manku, Gurmeet Singh, et al. "Symphony: Distributed Hashing in a Small World." *USENIX Symposium on Internet Technologies and Systems*. 2003.
- ON DEMAND TUNNELS PROVIDE 1 HOP SWITCHING BETWEEN CHATTY DEVICES

METHODOLOGY

- REQUIRES S + L + D LINKS PER NODE (S - NUMBER OF SUCCESSOR LINKS, L – NUMBER OF LONG-DISTANCE LINKS, D – NUMBER OF ON-DEMAND LINKS)
  - S AND D ARE CONSTANTS
  - L IS BOUND BY O(LOG(N)) - N IS THE NETWORK SIZE
- BOUNDS AVERAGE NUMBER OF SWITCHING HOPS IN NETWORK
  - LOG(N)

METHODOLOGY

- SWITCHING ARE RULES PROGRAMMED USING OPENFLOW
  - PEER NODES ACT AS SWITCHES
- SDN CONTROLLER QUERIES TOPOLOGY STRUCTURE FROM IPOP
  - EXCLUDES LEAF DEVICES
- BOUNDED FLOODING USED FOR BROADCAST
  - SPECIFIES SO FAR IN A CYCLE A THE RECEIVED MESSAGE IS TO BE PROPAGATED
  - PREVENTS BROADCAST STORM

CONTRIBUTION

- FULLY DISTRIBUTED
  - NO CENTRALIZED ROUTING TABLE OR SWITCHING/CONTROLLER COMPONENTS

CONTRIBUTION

- RESILIENT TO TRANSIENT FAILURES DUE TO CHURN AND TOPOLOGY RESTRUCTURING
  - PARTITIONS WILL FUNCTION WHILE THE TOPOLOGY HEALS

CONTRIBUTION

- ALLOWS UTILIZATION OF ALL SWITCHING LINKS
  - NO LINKS ARE DISABLED TO ELIMINATE CYCLES

VISUALIZATION

- TOPOLOGY VISUALIZATION IS A VITAL COMPONENT
  - OBSERVE FOREST FOR THE TREES

IPOP Visualizer

Demonstration

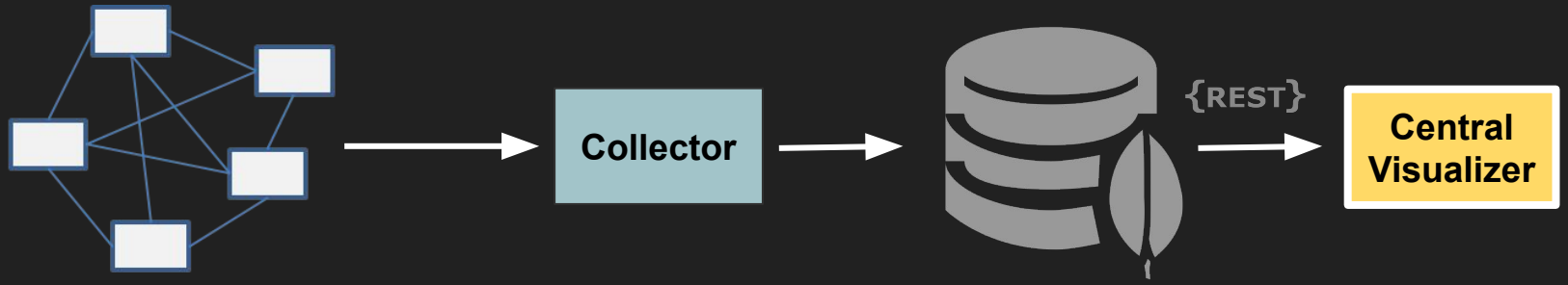
The PRAGMA36 Workshop, Jeju, Korea, April 22th-27th, 2019

IPOP Visualizer

- **Motivation:** Visualisations are essential to retrieve fast and easy access to different aspects of the network
- **Goal:** To provide visualization for network overlay that can reduce the expertise requirement to gain a well formed overview of the actual status and perhaps make a simple analysis of already collected data.
- **Main Monitoring Tasks:**
  - **Status including topology**
  - **Flow Monitoring**

Our Approach

- **Architecture:**

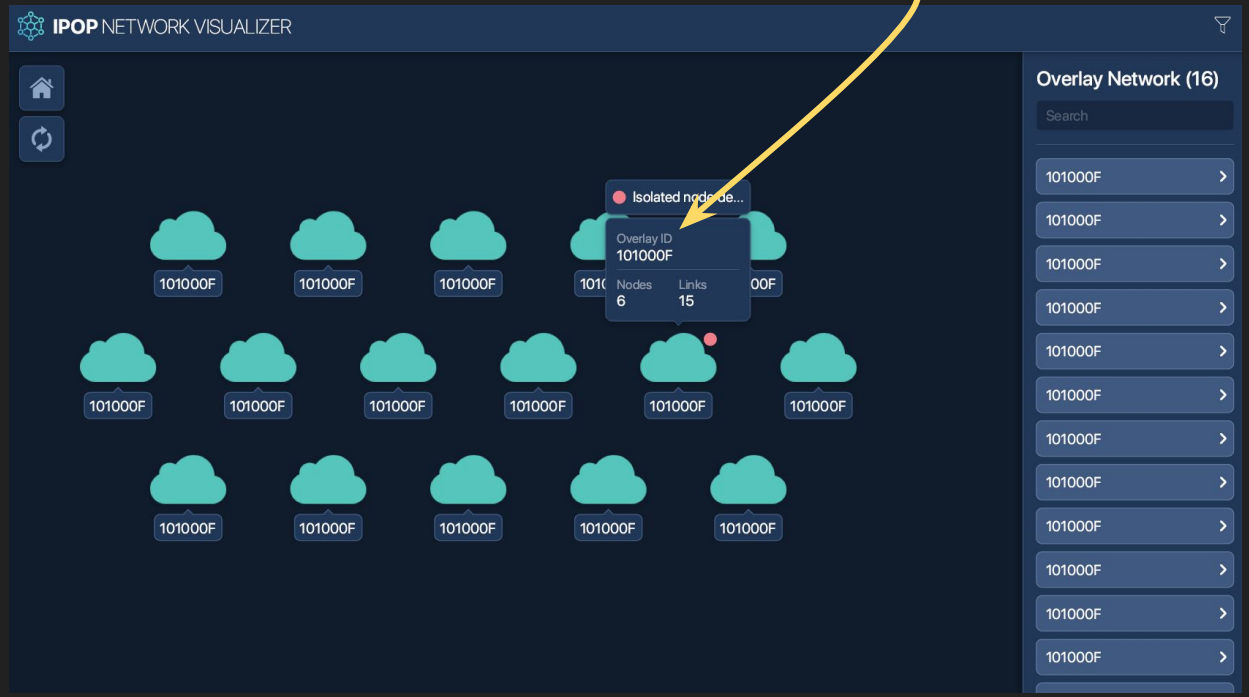


- **Ben Shneiderman:**

“Overview first, zoom and filter, then details-on-demand”

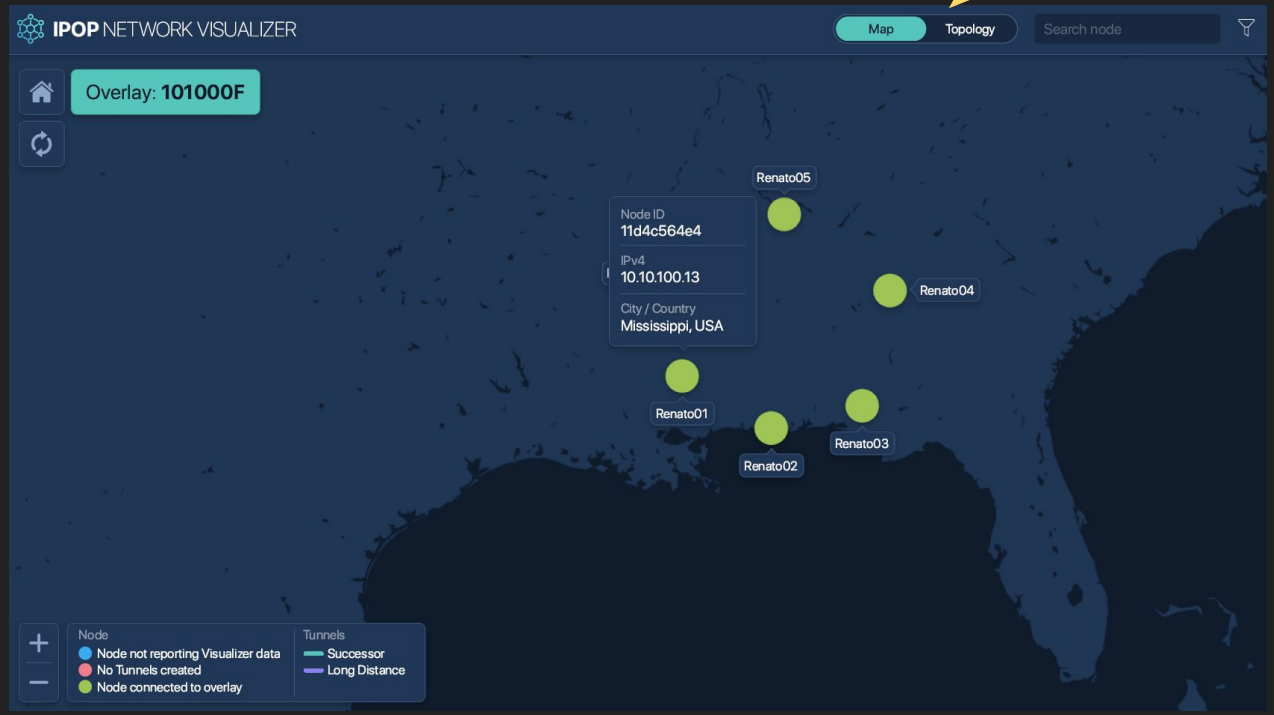
Our Preliminary Prototype (1)

- Display all IPOP network overlays



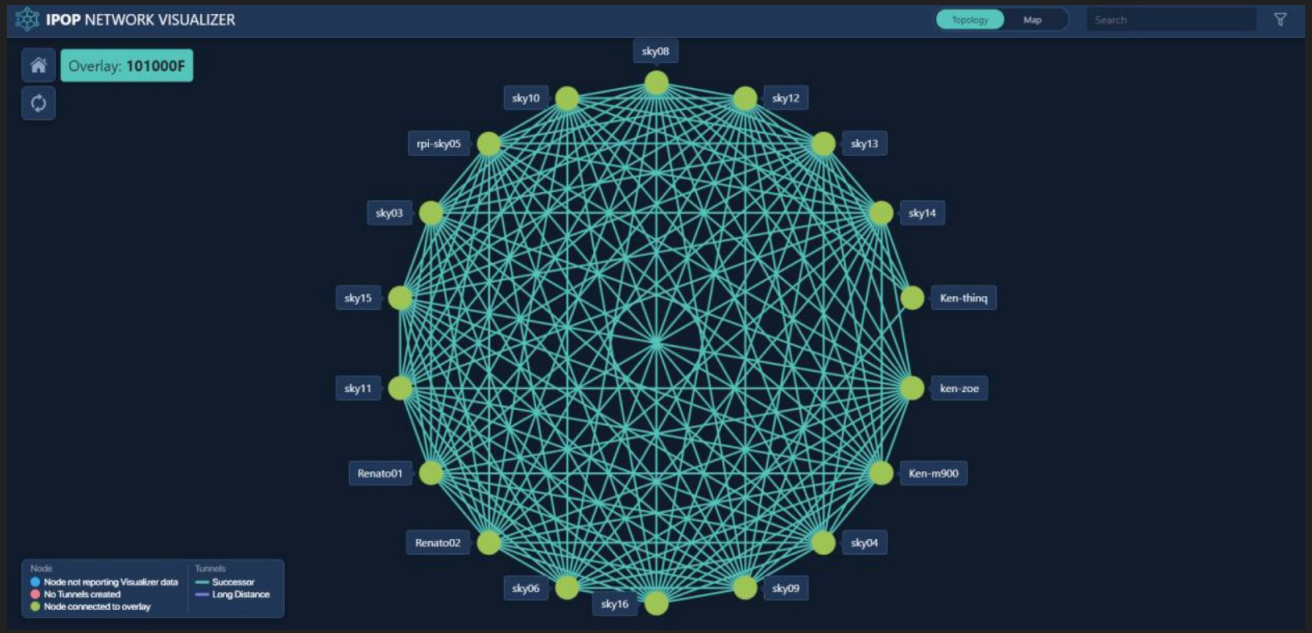
Our Preliminary Prototype (2)

- Two views: Geographical map and Topology



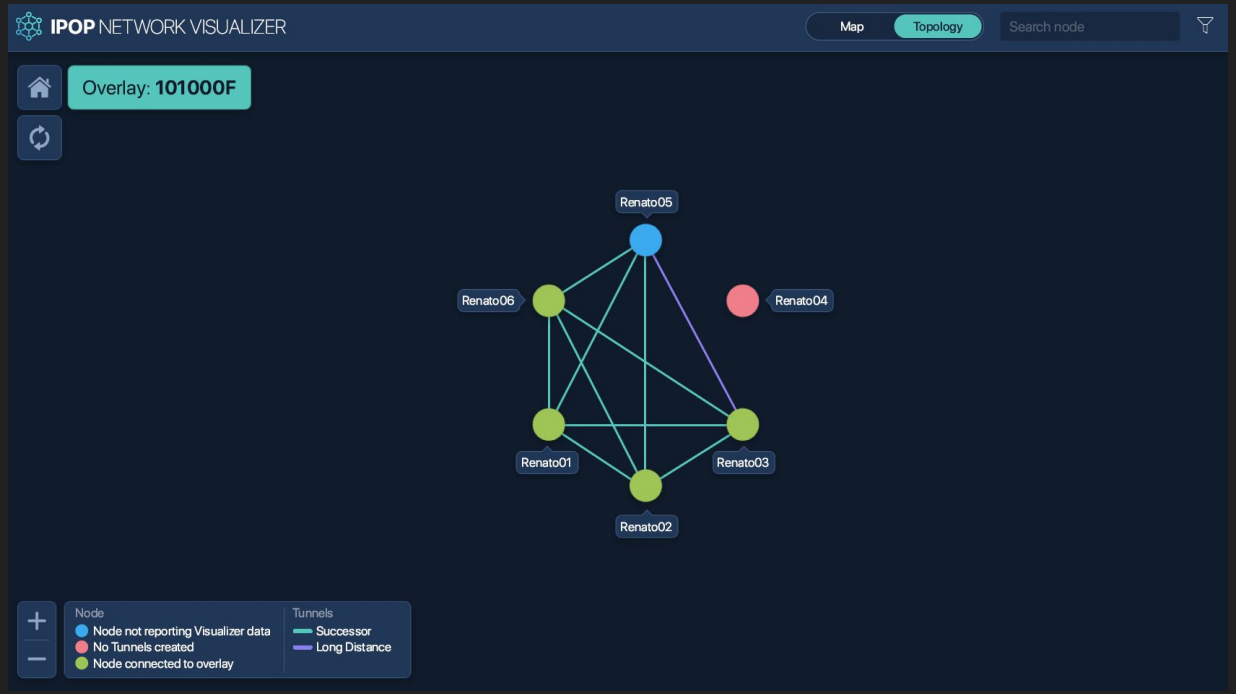
Our Preliminary Prototype (3)

- [See more in action]



Our Preliminary Prototype (4)

- **Distinct statuses via colors**



https://github.com/ipop-project/Network-Visualizer

Our Team Members

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