Scalable Layer 2 Topology and Forwarding for the Fog

Ken Subratie, Renato Figueiredo, Prapaporn Rattanatamrong,

Yoottana Boonpalit, Siwakorn Suwanjinda

Content

- Motivation
- Method
- Demonstration

Motivation

IoT promises a new era of application capabilities

Will connect billions of heterogenous devices to the internet

At this scale and distribution, existing approaches fail to meet management and application needs

New models are necessary to support device and application interaction from the cloud to the far edge.
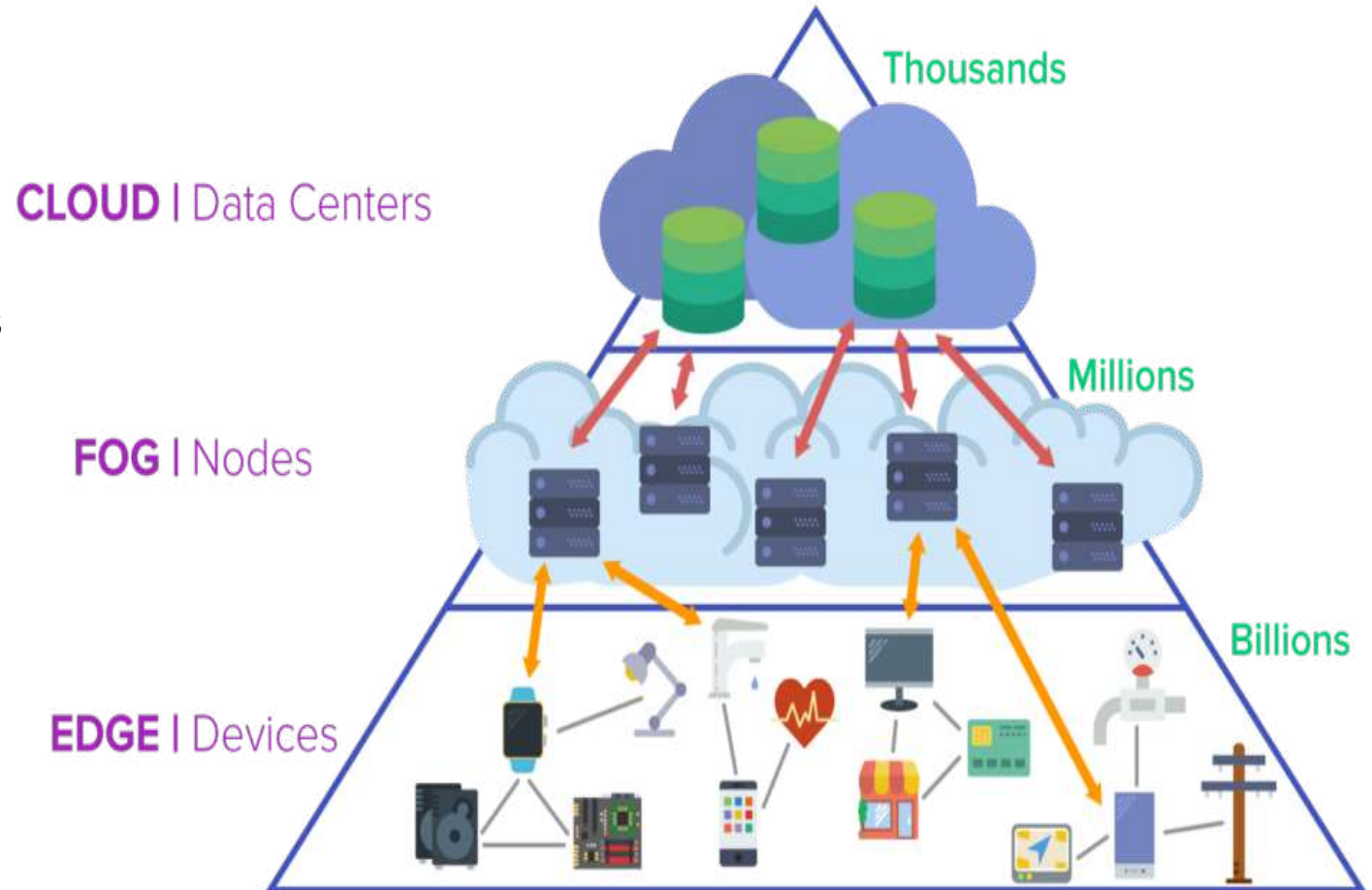
Virtualized Overlay Networks

- Virtualized Overlay Networks is one approach to address networking challenges
- Uses IP Tunnels to connect resources throughout the Fog
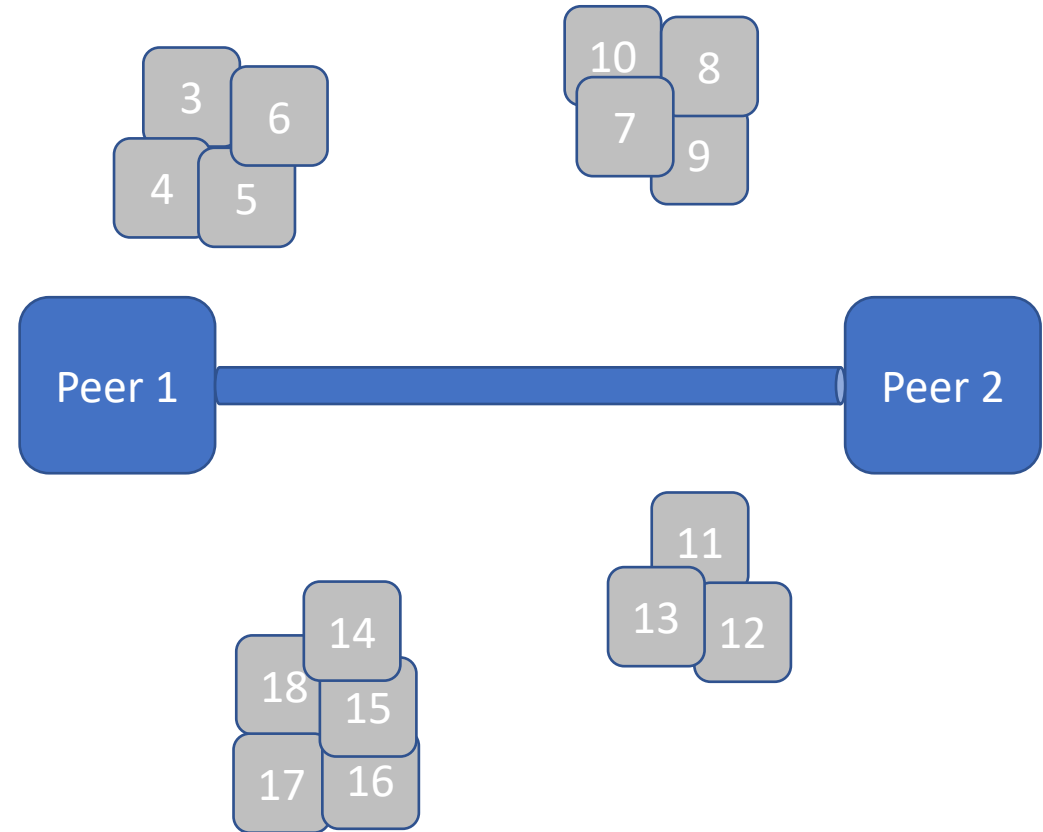
Tincan

Overlay network datapath implement in Tincan process

Tincan creates tunnels, encrypts and encapsulates ethernet frames and transmits/receives tunneling data.

Exposes fundamental software abstraction: IPOP-Tunnel

Creates a P2P link between 2 peers

Hosts observe a new (virtual) ethernet infrastructure

IPOP Controller

IPOP Controller provides tunnel management and orchestration
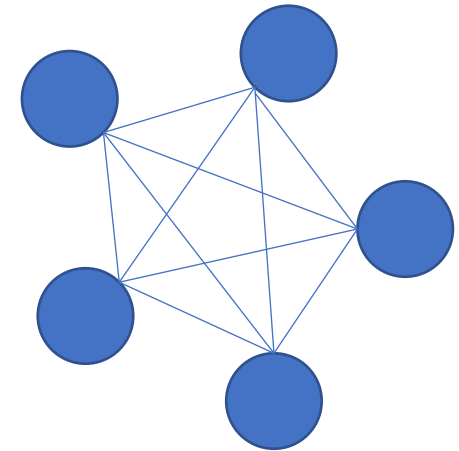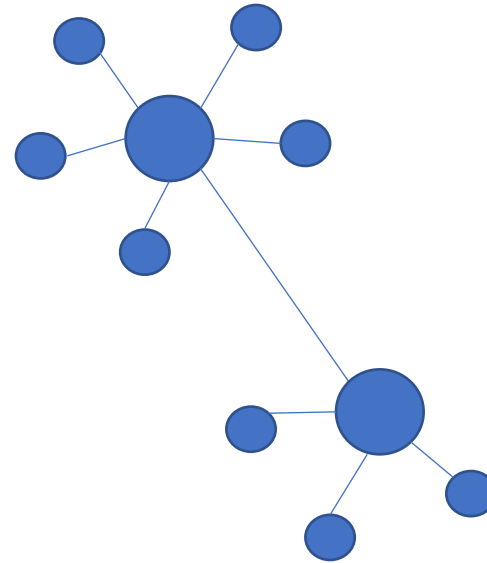
Decides when to create tunnels

Identify peers and determine which is selected as a tunnel endpoint

Provides important topology abstraction

Necessary for logical aggregation of multiple peers into collaborative network

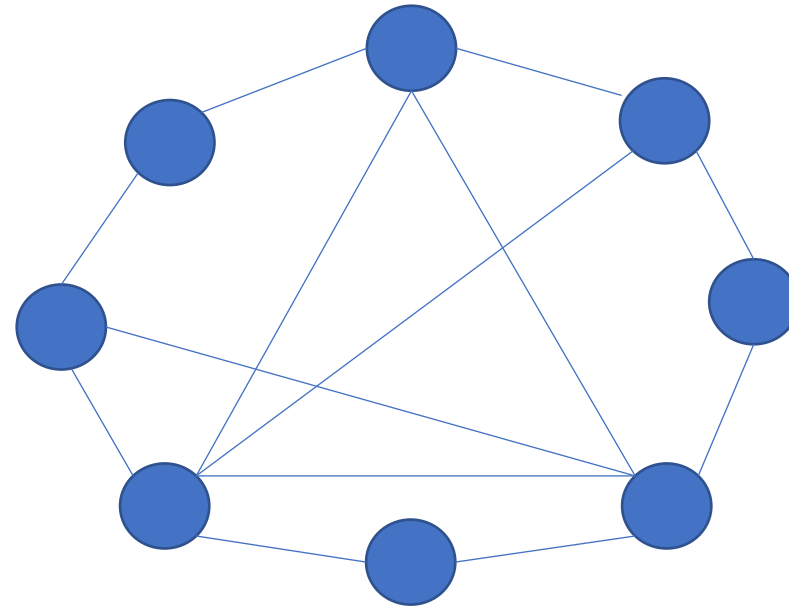Multiple possibilities exists: SVPN, GVPN, Star

Symphony Ring

IoT scale deployment requires scalable topology

Bounds the number of tunnels as a function of the number of nodes.

Creates an ordered ring, each linked to its successor with additional shortcut links cutting across the ring.

Layer 2 Loops

- Symphony Ring introduces multiple layer 2 loops

- Ethernet protocol does not handle loops

- Results in broadcast storm

- Requires additional procedure to handle loops e.g., STP, BoundedFlood

Bounded Flooding Switching

Node sends broadcast with maximum distance clockwise distance along the ring it can be safely retransmitted

Subsequent nodes repeat process using received bounds
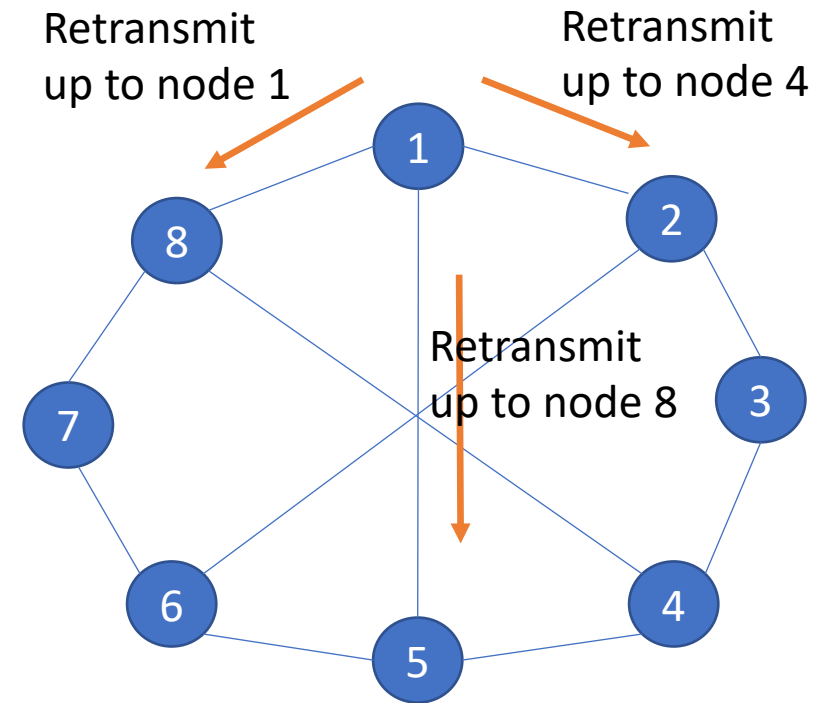
Network Visualization

- Provides 'big-picture' view
- No individual node tacks the state of entire system
- Nodes periodically report individual data to collection service
- Data is aggregated and stored in a database
- Available to web browser clients to view state of the system for a given period
- A launch pod for exciting future work
- Autonomous networking monitoring & troubleshooting

Demonstration

- Network Visualization using Web Services
- On Demand Tunnels as an optimization for sustained throughput transfers