Private Internet: A Global E2E Service Model

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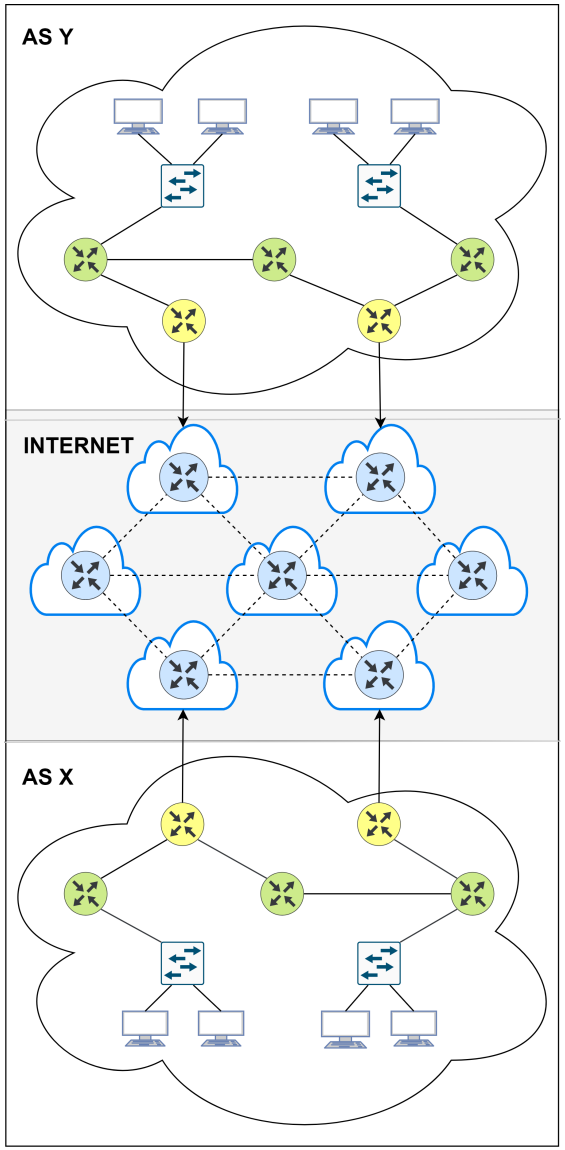
Internet: A Network of Autonomous Systems

How it works?

- Traffic originates as well as terminates at endpoints in periphery ASes called Access Networks (ANs).
- ANs route traffic destined for local endpoints using Interior Gateway Protocols (IGPs).
- ANs relay traffic destined for remote endpoints to their provider transit ASes.
- ASes peer with other ASes bilaterally using Border Gateway Protocol (BGP) to establish AS paths.
- ASes route traffic across themselves and the ANs using BGP AS paths.

Problems

- Endpoints don't have authority or mechanism to establish control over end-to-end paths.
- Peering policies do not account for revenue generated from content delivery.



Emergence of Global Private Networks

What is a Global Private Network?

- A network of networks that interconnects datacenters of large private cloud operators.
- Connects with other domains (mostly ANs) at various peering locations (public/private).
- Distributes content hosted in the network across datacenters and servers set up at ANs.
- Enables consumers to access content from just one AS hop away across their ANs.

Related Work: Zero Hop Networking

- Virtually merges AN and CP network into one single domain, hence "Zero Hop".
- Brings content provider (CP) control into ANs to introduce end-to-end path control.

Issues

- Content hosted elsewhere still uses public Internet to reach content consumers (CCs).
- Service quality is subjected to the inefficiencies of transit over public Internet.

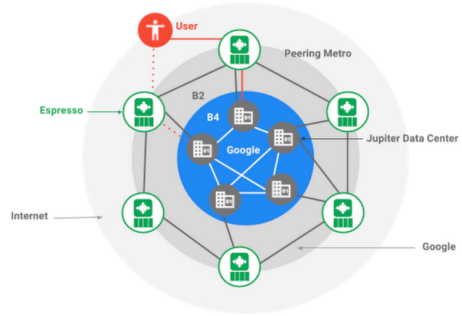


Figure: Google Espresso

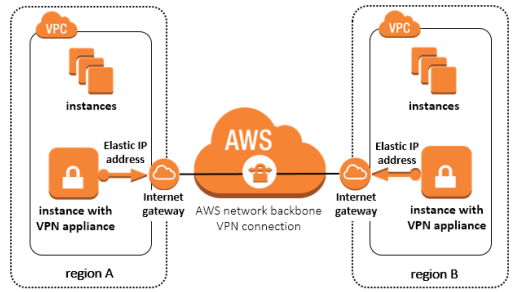


Figure: Amazon AWS

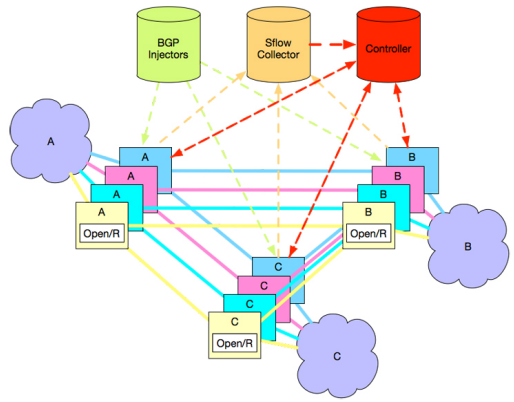
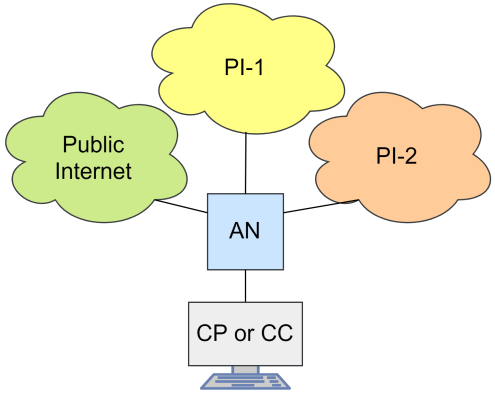


Figure: Facebook Edge Fabric

Private Internet: Vision

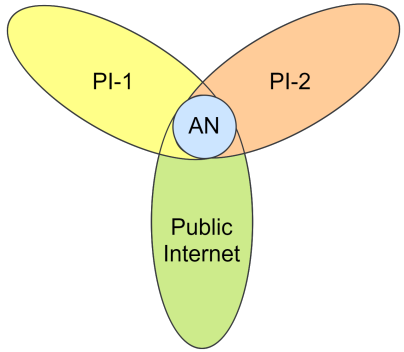
What is Private Internet?

- A service model to provide transit for content hosted by CPs without global infrastructure in ANs.
- An extension to zero-hop networks that provides transit for connected ANs.
- Enables communication between CPs and CCs at different ANs across a Global Private Network.
- Intends to control and optimize end-to-end service path across ANs and the Global Private Network.

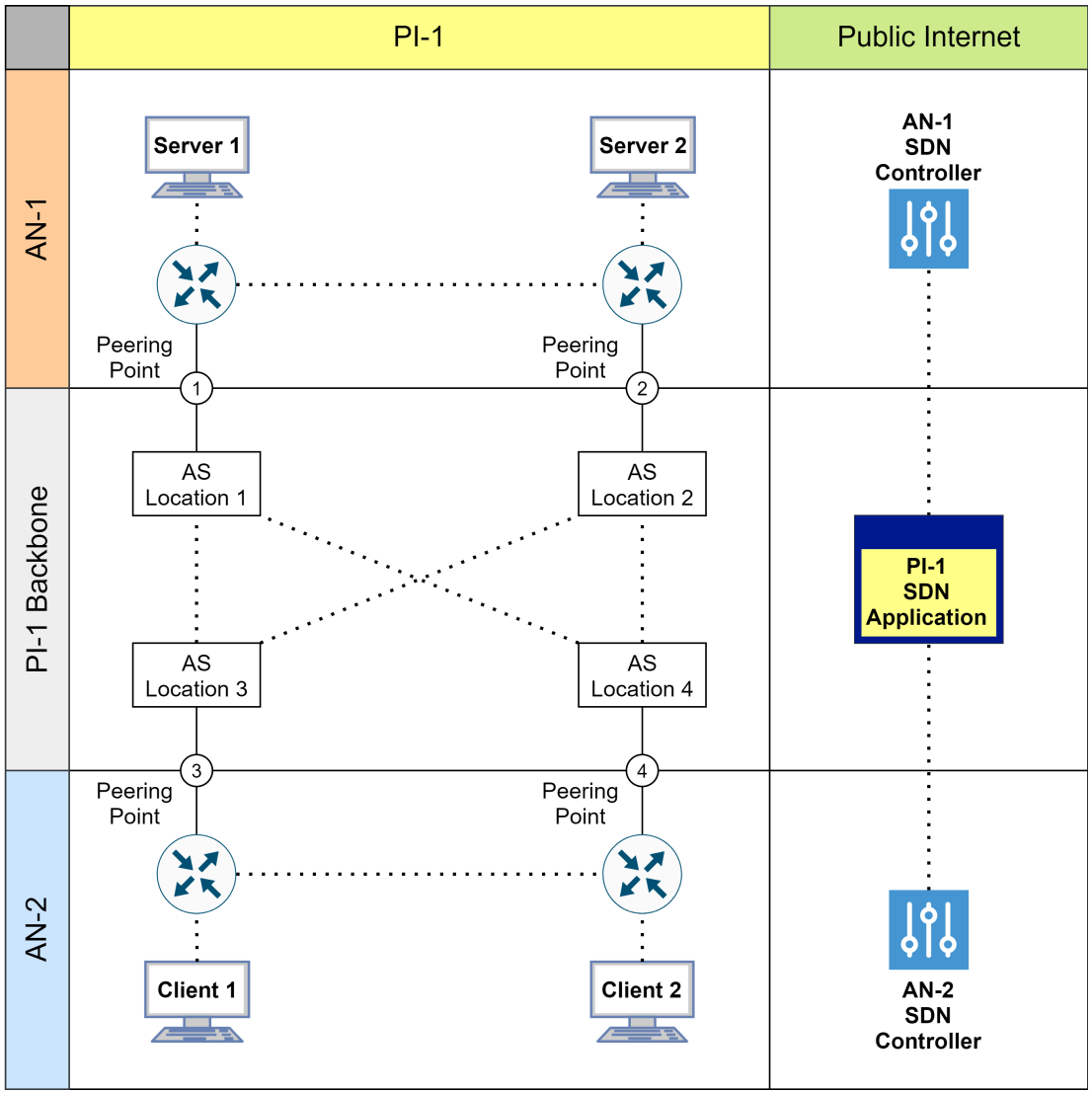


Benefits

- For Private Internet Operators: A new business domain.
- For emerging CPs: Better end-to-end traffic performance.
- For CCs: More options for end-to-end communication.



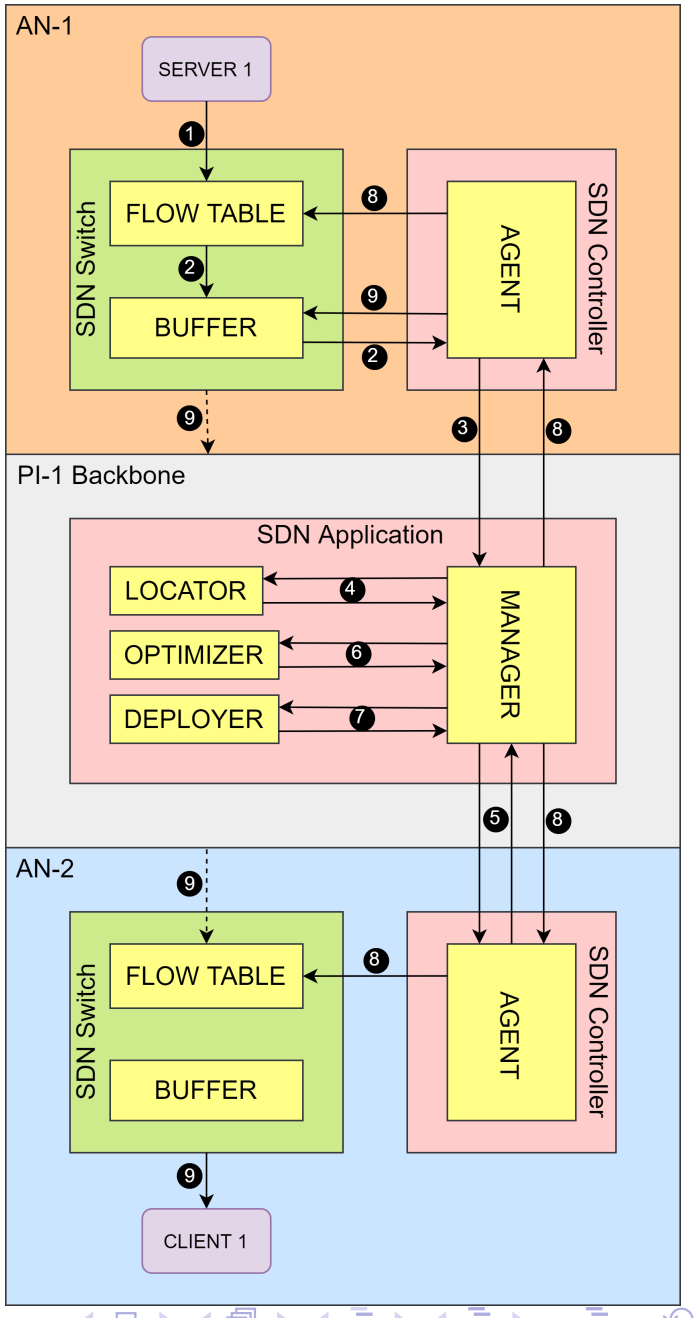
Private Internet: Sample Architecture



- SDN controllers at AN-1 and AN-2 interface with Public Internet as well as a Private Internet, PI-1.
- PI-1 Backbone hosts an SDN Application that communicates network state and control securely with the ANs over Public Internet.
- End-to-end paths are set up across PI-1 Backbone, AN-1 and AN-2.

Private Internet: Sample Workflow

1. Server1 sends a packet for Client1 to an SDN Switch in AN-1 network.
2. The Switch buffers the packet and sends it to the SDN Controller of AN-1.
3. The Controller sends a network configuration request to the SDN App running in PI-1 via Public Internet.
4. The App resolves location of Client1 (AN-2).
5. The App acquires reachability information for Client1 in AN-2 network from SDN Controller of AN-2 via Public Internet.
6. The App produces an optimal E2E path between Server1 and Client1 by evaluating provided SLAs and network state information.
7. The App configures the backbone part of the optimal path in its operator network.
8. The App instructs AN-1 and AN-2 controllers over Public Internet to configure the remaining part of the optimal path in their networks.
9. SDN Controller at AN-1 then instructs the switch to forward the buffered packet(s).



Private Internet: Ongoing Work

- How can an AN ensure that traffic from multiple Private Internet Operators (PIOs) are isolated from each other?
- How can the backbone part of the end-to-end path be deployed to handle inter-AN traffic and control?
- How can the endpoints determine which PI to utilize from among multiple PIs available at the ANs?
- How can we implement routing and control in such a multi-network environment in a scalable way?