

Implementing Telco Services with the Cloud

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MPLSS & AI NET
WORLD 23

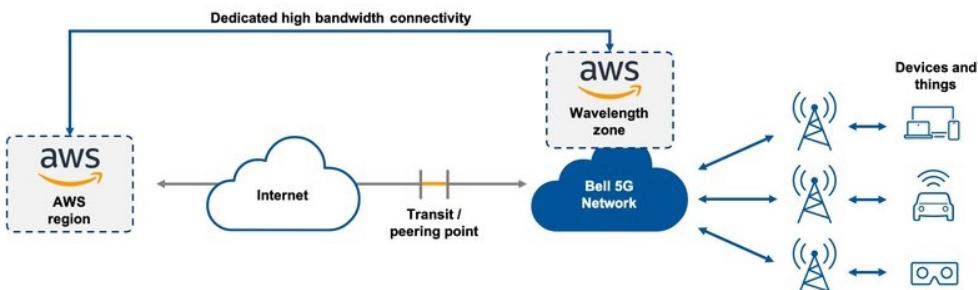
The Great Hyperscaler Collaboration

- Global operator movement (Bell included) to collaborate/partner with major hyperscalers.
- Few years ago, this would have been inconceivable ... but the race to 5G changed the game.
- Now, most operators are either moving, collaborating or evaluating to do so.

... and some are already evaluating how to comeback !

Bell and Amazon Web Services bring 5G Edge Compute to Canada

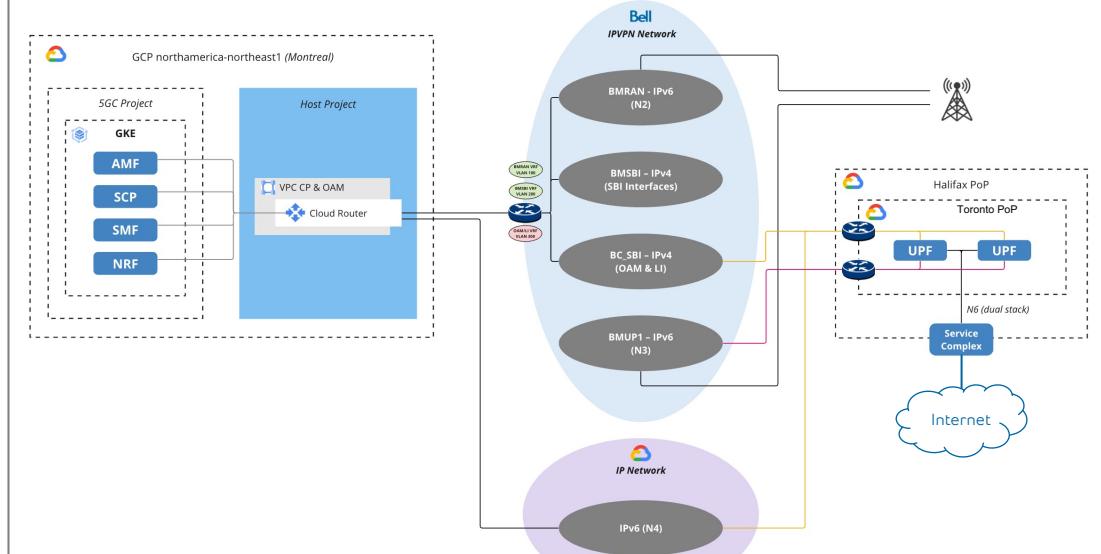
Bell extends its 5G leadership by deploying the first AWS Wavelength Zone at the edge of Canada's most awarded and fastest-ranked 5G network



<https://www.bce.ca/news-and-media/releases/show/Bell-transforms-customer-experiences-and-extends-5G-leadership-by-collaborating-with-AWS-for-cloud-and-5G-multi-access-edge-computing?page=4&month=&year=&perpage=25>

Bell partners with Google Cloud to deliver next-generation network experiences for Canadians

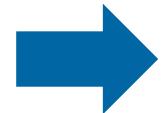
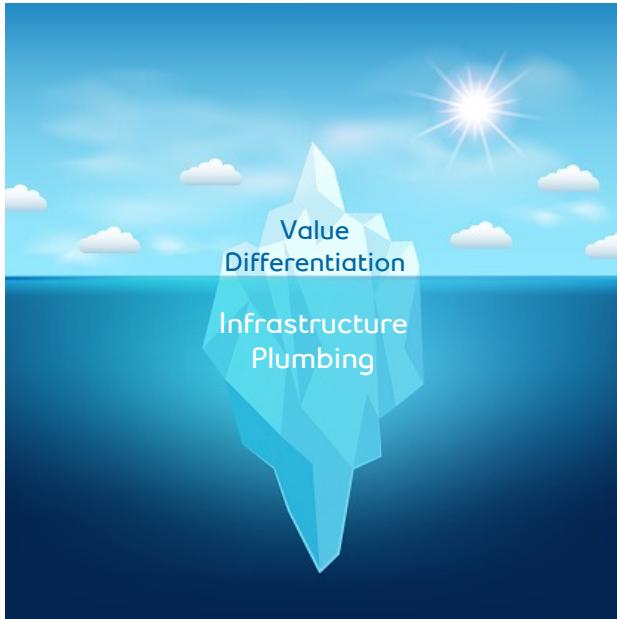
Multi-year strategic partnership will modernize Bell's technology infrastructure and deliver a richer customer



<https://www.bce.ca/news-and-media/releases/show/Bell-partners-with-Google-Cloud-to-deliver-next-generation-network-experiences-for-Canadians?page=6>

Why this Movement ?

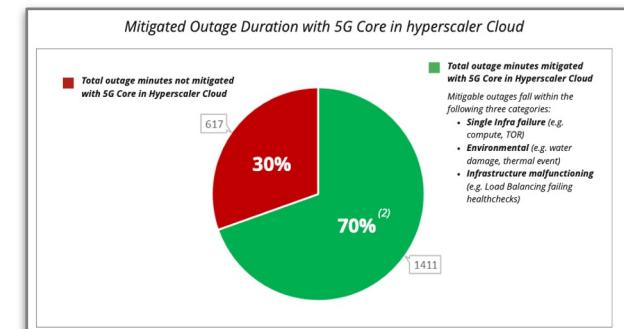
- All-in-one service providers are disaggregating into subsets of specialized providers.
- To switch efforts towards **rapid innovation or new product delivery** and more focus towards **research**.
- Delegate operations to focus more on Planning, Design and Architecture or Business Strategy *



- Adopt fit-for-purpose public cloud technology
- Embrace true hyper scaler practices to innovate and scale
- Driving new services at a velocity, volume and cost not previously achievable
- Shift from technology delivery to product delivery.

- Integrated/deployed a 5GC (start to finish) in less than a week compared to months.
- Shift from \$/Bps to complete TCO viewpoint through cloud-native operations.
- An estimated 70% of mitigated outage minutes if leveraging hyper scaler clouds for 5G Core..

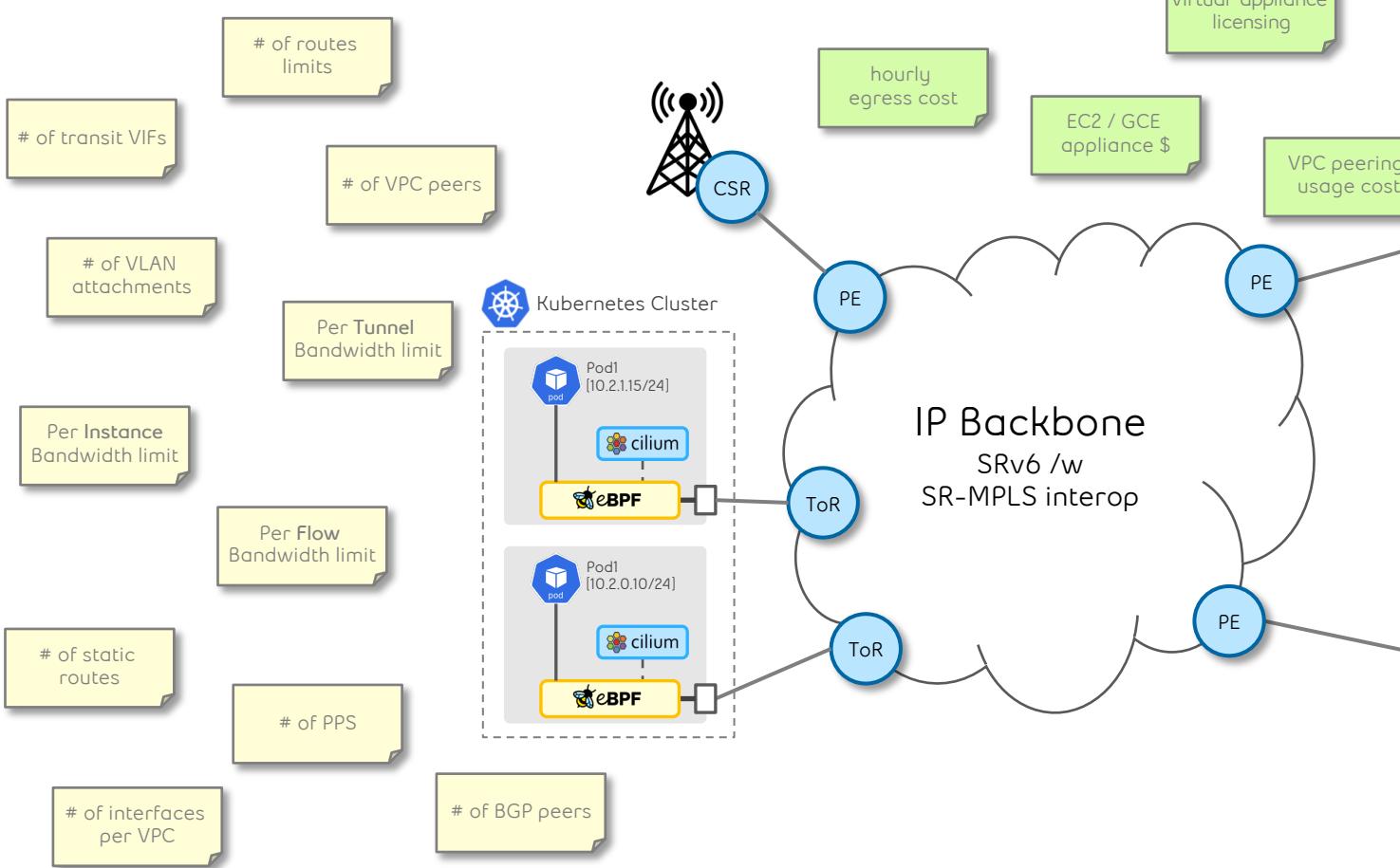
smf-pdu pod (v1)			smf-pdu pod (v2)		
Upgrade Process Started	smf-pdu v1	smf-pdu v1	smf-pdu v1	smf-pdu v2	
33% Completed	smf-pdu v1	smf-pdu v1	smf-pdu v1	smf-pdu v2	
X	X	X	X		
66% Completed	smf-pdu v1	smf-pdu v1	smf-pdu v1	smf-pdu v2	
X	X	X	X		
100% Completed	smf-pdu v1	smf-pdu v1	smf-pdu v1	smf-pdu v2	
	Data Center (AZ-A)	Data Center (AZ-B)	Data Center (AZ-C)	Data Center (AZ-A)	Data Center (AZ-B)
					Data Center (AZ-C)



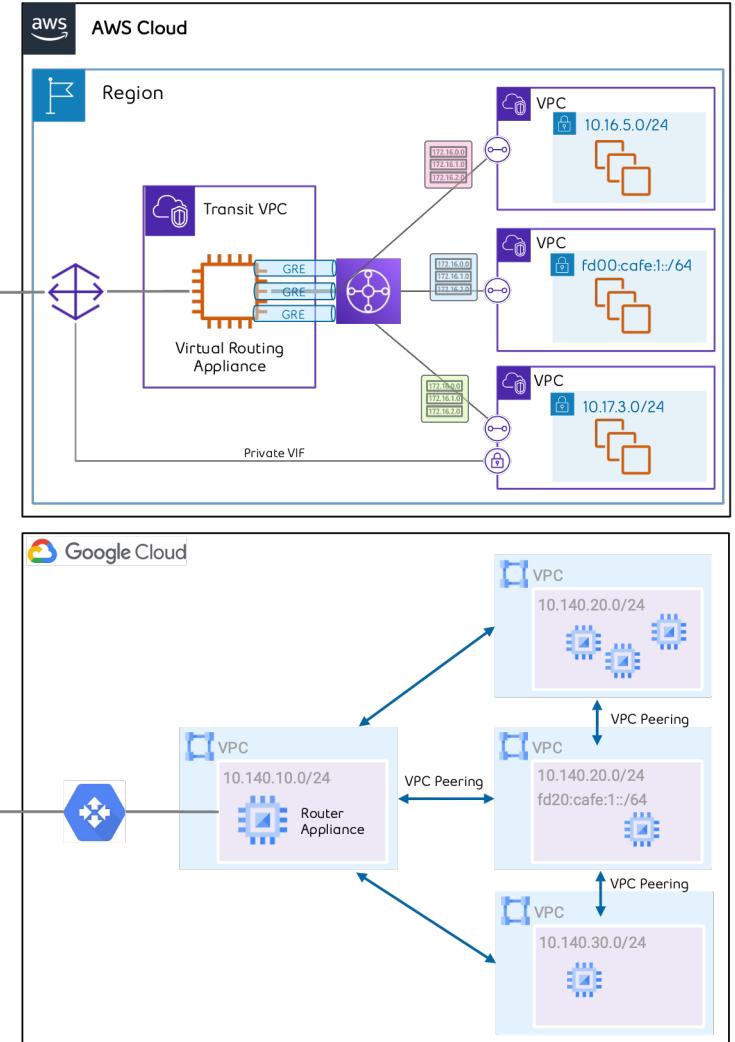
* <https://virtualizationreview.com/articles/2019/10/21/cloud-trends.aspx>

Into the realm of Limits, Quotas and FinOps

- There is no such thing as a “free meal” when thinking about cloud networking ... literally.
- Effectively extending an operator network to the cloud is nothing short of **epic**.
- Most 3rd party cloud networking solutions usually **add even more complexity**.



... and the list goes on



What if we tried to drastically simplify cloud networking instead ?

3.2 Gaps & Challenges in Today's Communication Services

The Network 2030 initiative is a structured approach to defining the capabilities of networks and corresponding communication services for the decade following 2030. The goal is to have networks ready for the market verticals that will utilize emerging technologies in 2030. Network 2030 extrapolates from what we know about technologies and develops a vision of the new media, new services, and new infrastructure. For this, we outline a few areas of importance to address towards building this vision.

Lacking service-network interaction: Failure to find an ordered and healthy relationship between the applications and the network has been a sticking point. Connectivity is just one of the workflows involved in application logic. It is a service consumed, with reachability being the only explicit means of setting up the application behaviour in the networks. However, a number of services offered by networks are not obvious to the end user. These include reliability of the network fabric, broadcast or multicast, integrity and security of data delivered, and network level awareness of congestion, capacity, and latency. Accommodating for such capabilities directly in the networks have been much of the focus of industry for the past thirty years. *Due to lack of direct support for such services through proper interfaces to the network, application developers have been left in a limbo, designing for every conceivable possibility of network failures and outages.* Many of these services are controlled over end-to-end interfaces between the endpoints using the transport (TCP) layer which is another example of free-form evolution aiming to solve the problems of the network without sufficient assistance from the networks.

[Network 2030 - A Blueprint of Technology, Applications and Market Drivers Towards the Year 2030 and Beyond](#)

Invisinets: Removing Networking from Cloud Networks

Sarah McClure*, Zeke Medley*, Deepak Bansal*, Karthick Jayaraman*, Ashok Narayanan†,
Jitendra Padhye*, Sylvia Ratnasamy*†, Anees Shaikh†, and Rishabh Tewari*
*UC Berkeley †Google *Microsoft

"In other words, *we believe that the best way for tenants to think about networking is to not think about networking at all.*"

<https://www.usenix.org/system/files/nsdi23-mcclure.pdf>

Get the Network Out of the Way



Getting the network out of the way has been very important for me in my thinking about networks, and is an easy way to help talk about a bunch of very important concepts, decisions, and arguments. This can sound trite, obvious, or insulting. In this post I'll try to describe the concepts I'm talking about and illustrate with some of most important examples in my career.

The more that the network is noticed the worse things are for everyone. Often times, especially when the network is noticed, networking and network engineers are thought of negatively. Instead, if you think of it as a challenge it can help you focus on making a great network. You can think about your goals: how important it is to keep the network working well, to not disrupt the business, and to be able to keep up with any changes that the business needs.

From Software Defined to Application Defined

- SDN is still fundamentally about packet delivery and connection management
 - ◆ Naturally, networking community optimizes for these concepts
- Application developers do not care about packets or connections; even the concepts are meaningless

Leveraging SRv6 to evolve multi-cloud connectivity

- Let's assume everything was IPv6 ... would we need to use overlay VPNs ? *
- Unfortunately, existing technical or business constraints still require us to perform some sort of segmentation.
- SRv6 lets us achieve both end-to-end IPv6 **WITH** VPN service capabilities.
- When deployed at the upmost edge of a flow (host) SRv6 allows for **MASSIVE** cloud networking simplification.

SIMPLICITY

Hyperscaler networks only needs to carry locator address space, no added complexity

COST EFFICIENCY

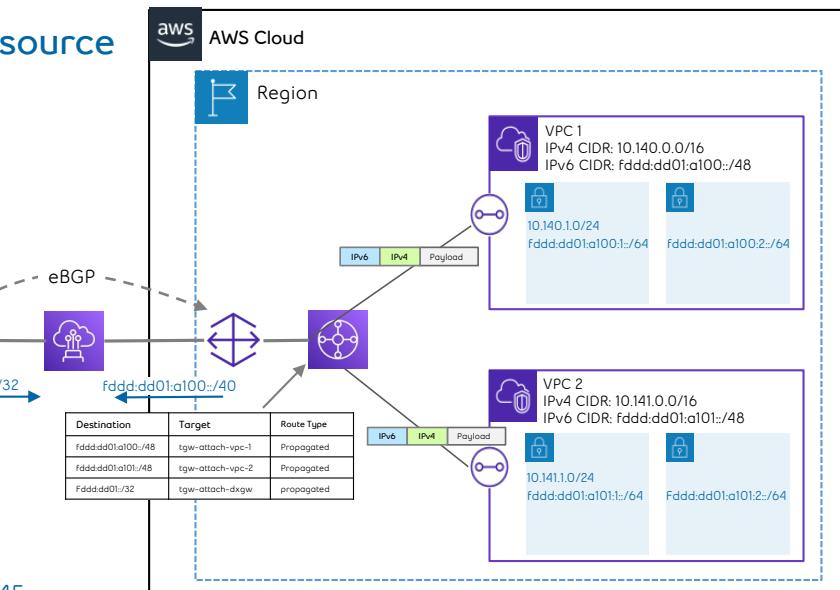
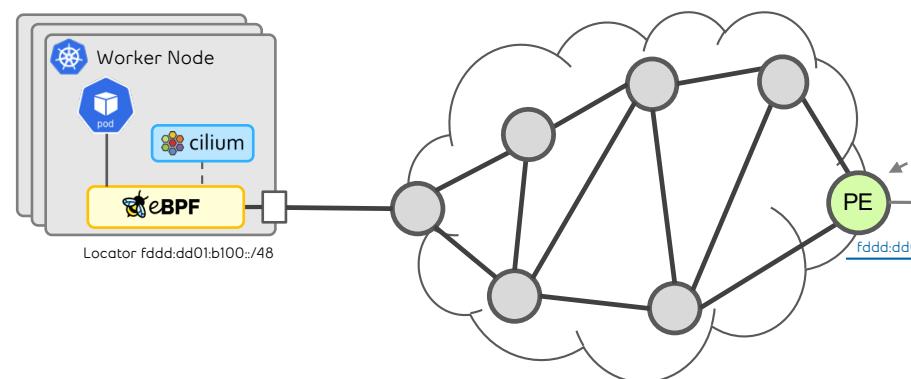
Reduced need for add-on cloud features or extending quota limits.

PERFORMANCE

Even without flow-label, SRv6 allows optimized flow performance (1 flow per uDT/DX or END function)

OBSERVABILITY

Integrated underlay/overlay, encapsulation initiated at source



* Ref: Nicola Leiva, Three reasons why we need IPv6 in Kubernetes - May 2020

https://docs.google.com/presentation/d/1wYAZYt8FSmkGKvu_4dI0yjcUFwjXQDz7XKB2qnequEc/edit#slide=id.g7821a8aef3_2_45

Enabling SRv6 on Telco private clouds

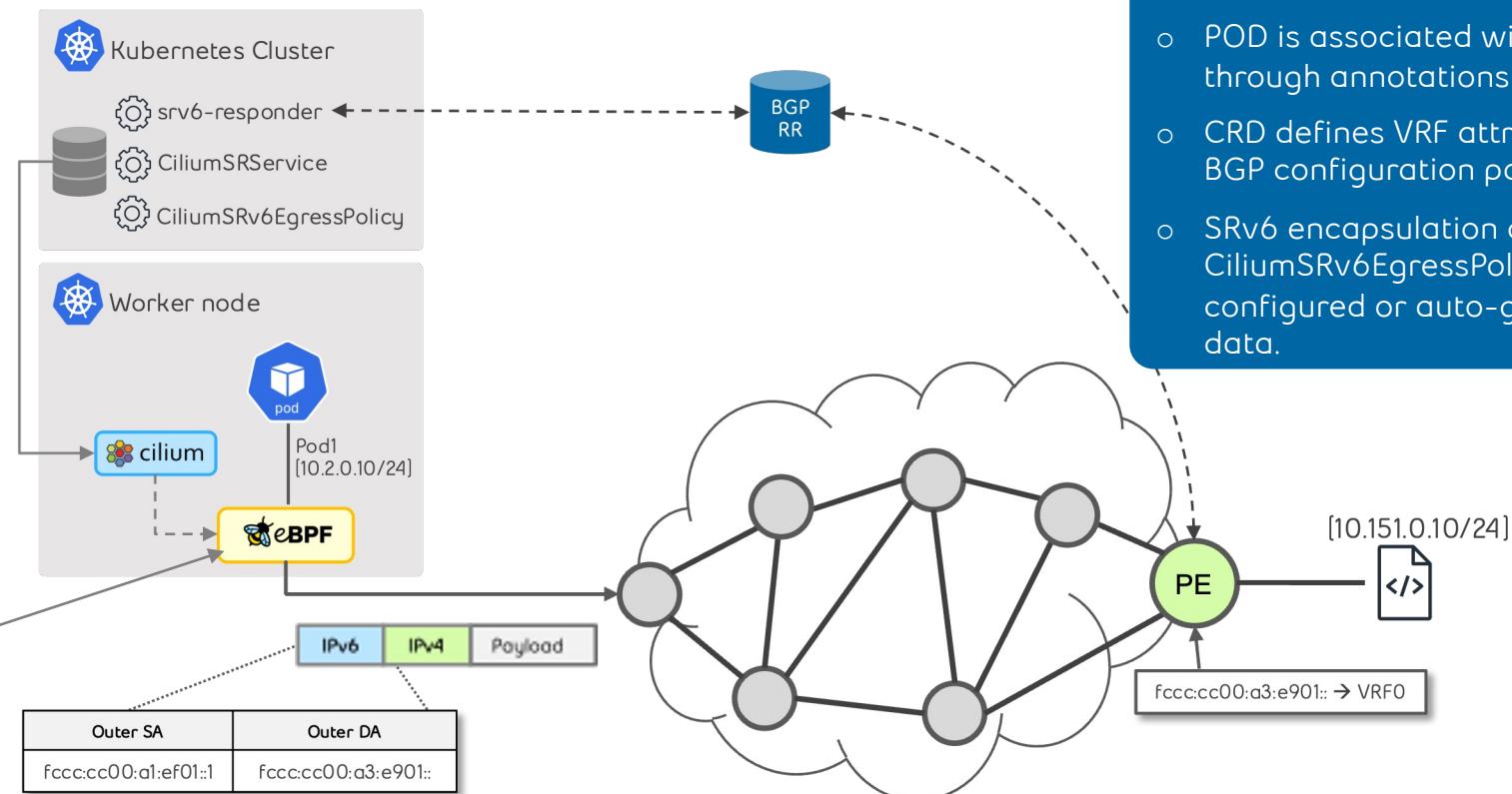
```
ipv6:  
  enabled: true  
srv6:  
  enabled: true  
  encapMode: reduced  
bgpControlPlane:  
  enabled: true
```

```
apiVersion: "cilium.io/v2alpha1"  
kind: CiliumBGPPeeringPolicy  
metadata:  
  name: pe0  
spec:  
  nodeSelector:  
    matchLabels:  
      kubernetes.io/hostname: srv6-responder  
  virtualRouters:  
  - localASN: 64577  
    exportPodCIDR: true  
    mapSRv6VRFs: true  
    neighbors:  
    - peerAddress: "fccc:cc00:1:1"  
    peerASN: 64577
```

```
apiVersion: cilium.io/v2alpha1  
metadata: kind: CiliumSRv6VRF  
name: vrf0  
spec:  
  vrfID: 1  
  importRouteTarget: "64577:661"  
  exportRouteTarget: "64577:661"  
  rules:  
  - selectors:  
    - podSelector:  
      matchLabels:  
        vrf: vrf0  
    destinationCIDRs:  
    - 0.0.0.0/0
```

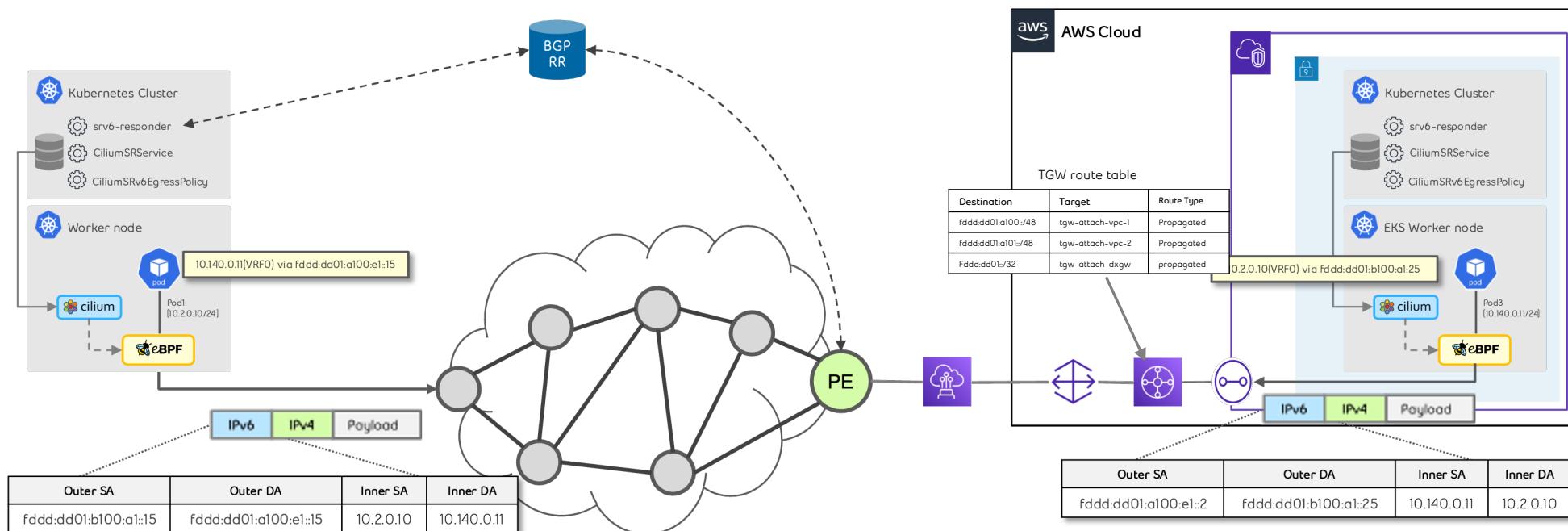
```
apiVersion: cilium.io/v2alpha1  
kind: CiliumSRv6EgressPolicy  
metadata:  
  creationTimestamp: "2022-05-16T02:03:15Z"  
  generation: 1  
  name: bgp-control-plane-  
  resourceVersion: "791"  
  uid: f8519c91-d6d3-4cc8-941d-e5efd69e4317  
spec:  
  destinationCIDRs:  
  - 10.151.0.10/24  
  destinationSID: 'fccc:cc00:a3:e901::'  
  vrfID: 1
```

- Leveraging widely adopted Cilium project in use by all major Kubernetes releases
- Collaboration effort with Isovalent to augment Cilium CNI to support SRv6 encapsulation.
- Currently in **private-preview for release 1.13 of Cilium Enterprise Edition**.
- Successful interop testing done with IOS-XR, FRR, GoBGP, JUNOS and ArcOS
- Aligned with multi-network KEP in sig-network <https://github.com/kubernetes/enhancements/pull/3700>



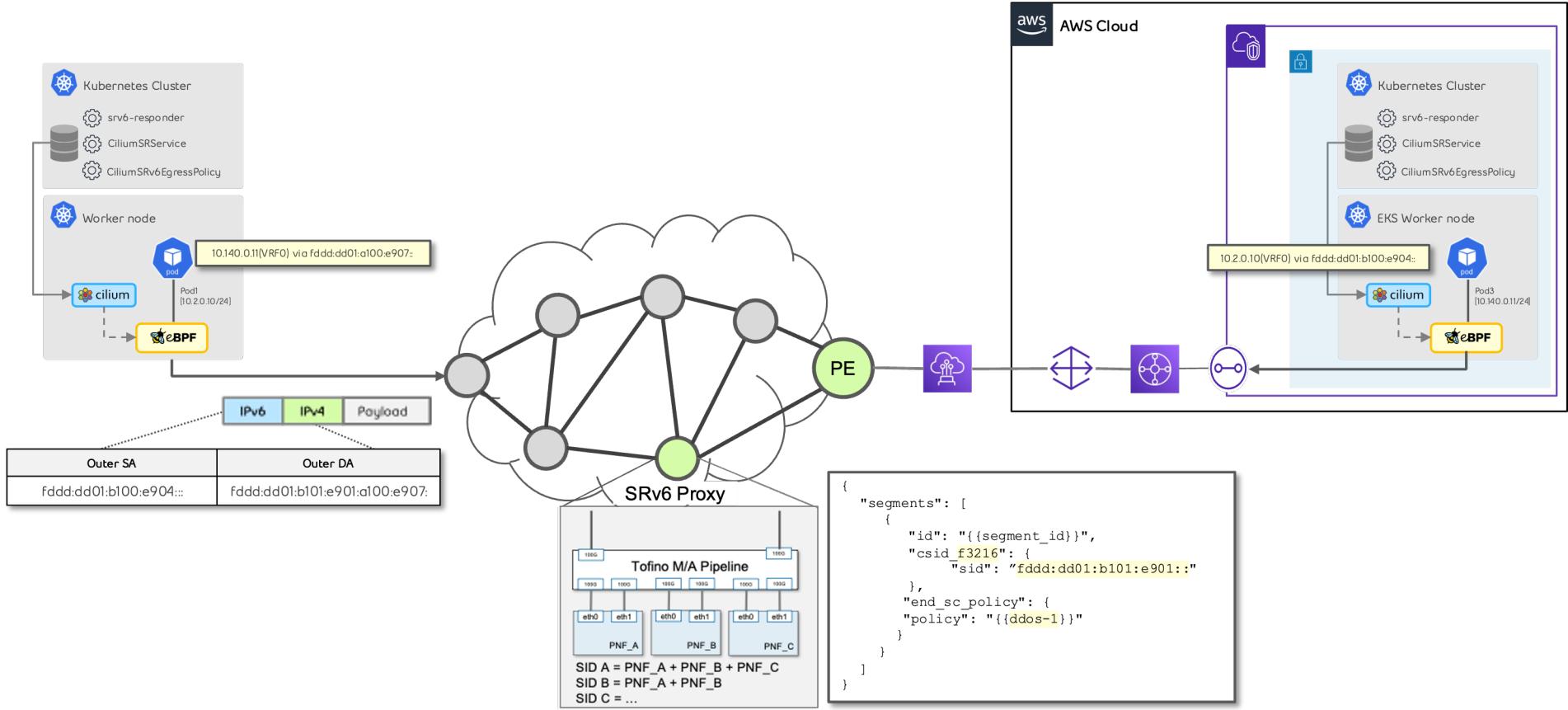
Extending SRv6 from Private to Public Cloud

- Work in progress to extend SRv6 over hyperscaler cloud infrastructure.
- Only possible with H.Encaps.Red or with SRH with f128 encoding due to ULA addressing limitations with hyperscalers.
- Collaborating extensively with AWS to enable Cilium Enterprise Edition with EKS Kubernetes release.
- EC2 or Google Compute Engine instances can either use eBPF for standalone workloads or leverage the right kernel implementations (kernel 6.1 for CSID support).
- Does not preclude deploying virtual routing appliances for non cloud-native workloads.



Inserting inline value-add network services

- Coming full circle with the work presented last year, leveraging in-network SRv6 proxy function.
- Can easily insert logically inline services through SRv6 service programming policies.
- Services can be inserted at any location in the network and steered using SRTE explicit paths.
- Paths can be configured via standard NETCONF or API driven through CRDs, P4RT(gRPC) or PCE.



In Conclusion

- Host based end-to-end SRv6 is currently possible in DC/Private cloud deployments
- With lots of new opportunities and innovations around the corner
- **Optimal efficiency in any cloud comes with uSID**
 - Data plane efficiency (HW Proxy, even eBPF complexity)
 - Massive scale and simplified operations
 - Overall simplicity
- However, some work is required with hyperscaler infrastructure for to achieve a truly unified uSID forwarding plane.



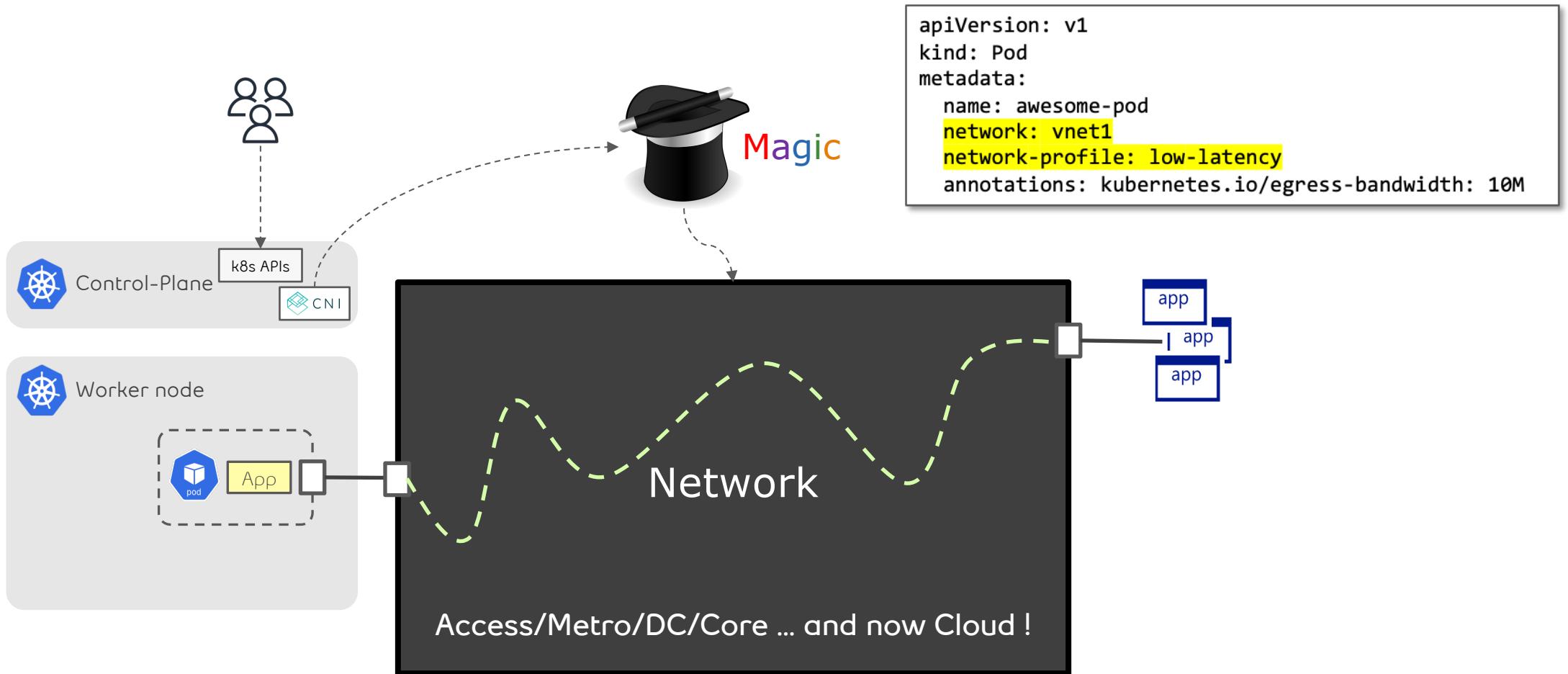
Google Cloud

- Support for IPv4 protocol in next-header after IPv6 encap
- Ability to filter IPv4 prefixes out of VPC peering policies.
- Support for customer defined ULA addressing space (ie not forced fd20::/20)
- Support for BYOIPv6 address space including ULA



- Support for ULA addressing space (roadmap)
- Support for BYOIPv6 ULA address spaces (roadmap)
- Support for flexible CIDR ranges for IPv6
- Support of hashing based on IPv6 flow labels.

One step closer to Utopia !





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