Securing Microservice Interactions in Openstack and Kubernetes

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https://www.banyanops.com

Banyan

- Founded in the middle of 2015
  - In San Francisco, CA
- Veterans from VMware, HP Labs, and Moovweb
  - 50+ patents and publications in Virtualization, Network Security, and Big Data
- Incubated at Stanford's StartX accelerator
  - Currently our product is in private beta

Outline

1. Introduction to Microservices
2. Dynamic and sprawling attack surface
3. Frankensteining existing solutions
4. A New approach to Application Security
5. Demo
6. Conclusions & discussion

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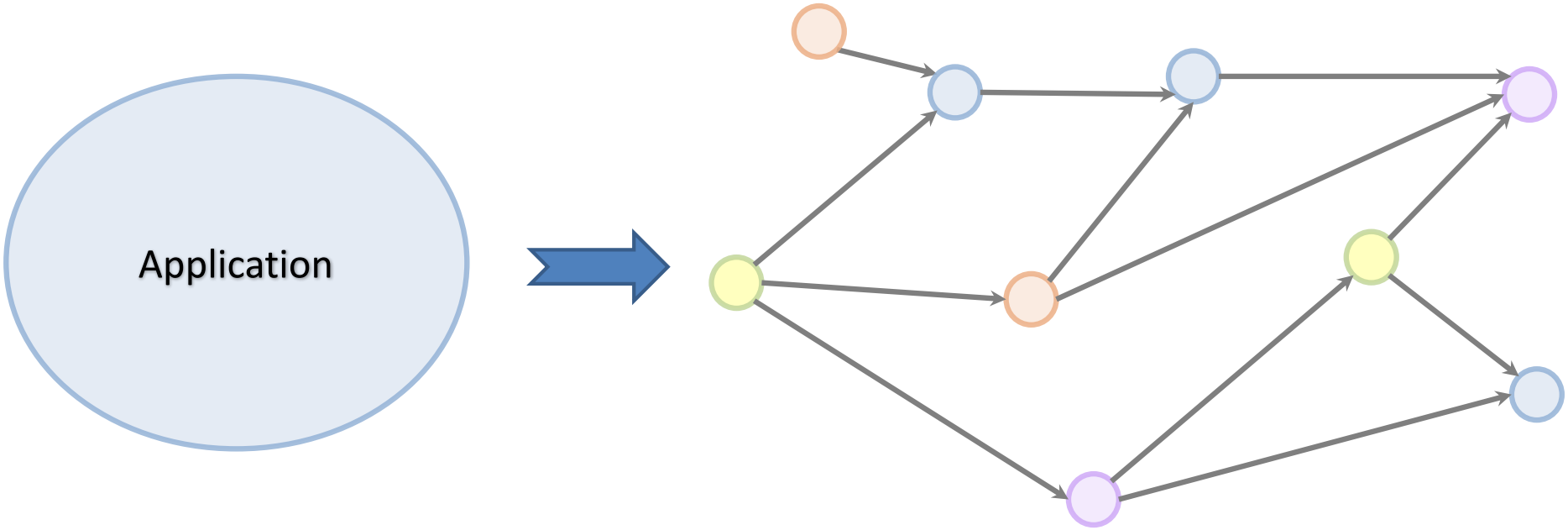
Transitioning from Monoliths to Microservices

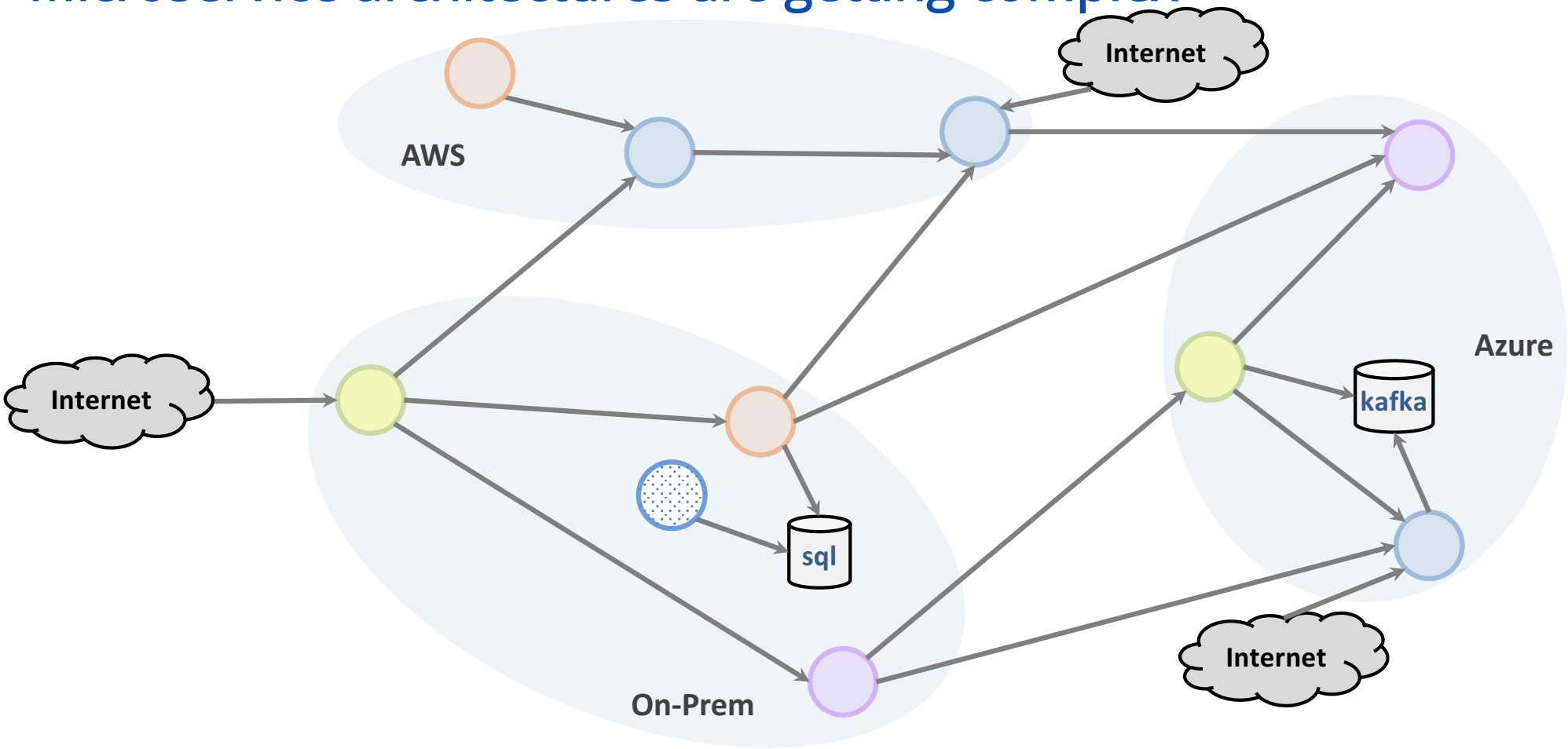


Benefits of Microservice architecture

- People
  - Allows different teams to build single-purpose application components independently
- Process
  - Enables fast deployment (months -> days/hours) from development to production
- Technology
  - Each team can independently evolve their own development and deployment stacks

Caveat: Not all applications fit this architecture

Microservice architectures are getting complex



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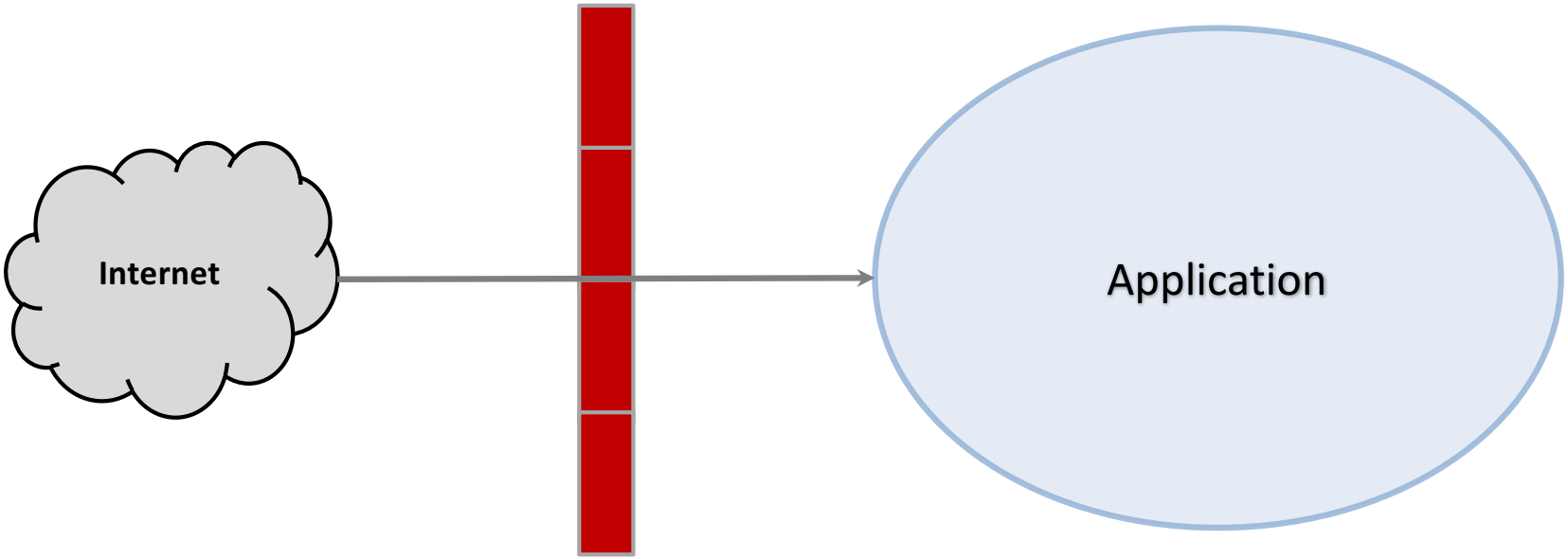
Securing monoliths



AppSec

API Gateways
TLS Proxies
App Firewalls/RASP

NetSec

Segmentation
Network Firewalls/Gateways
IPS/IDS systems

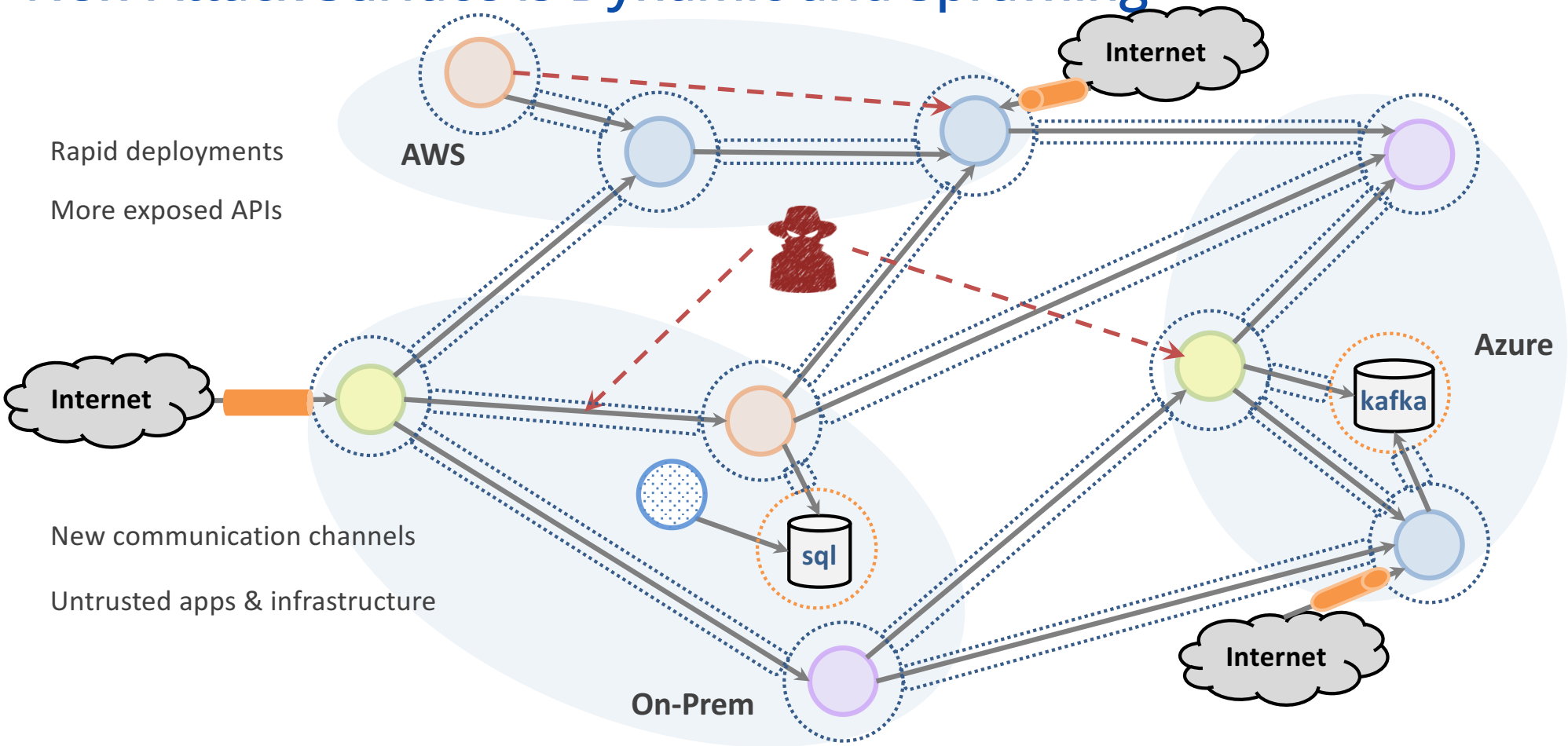
New Attack Surface is Dynamic and Sprawling

Rapid deployments

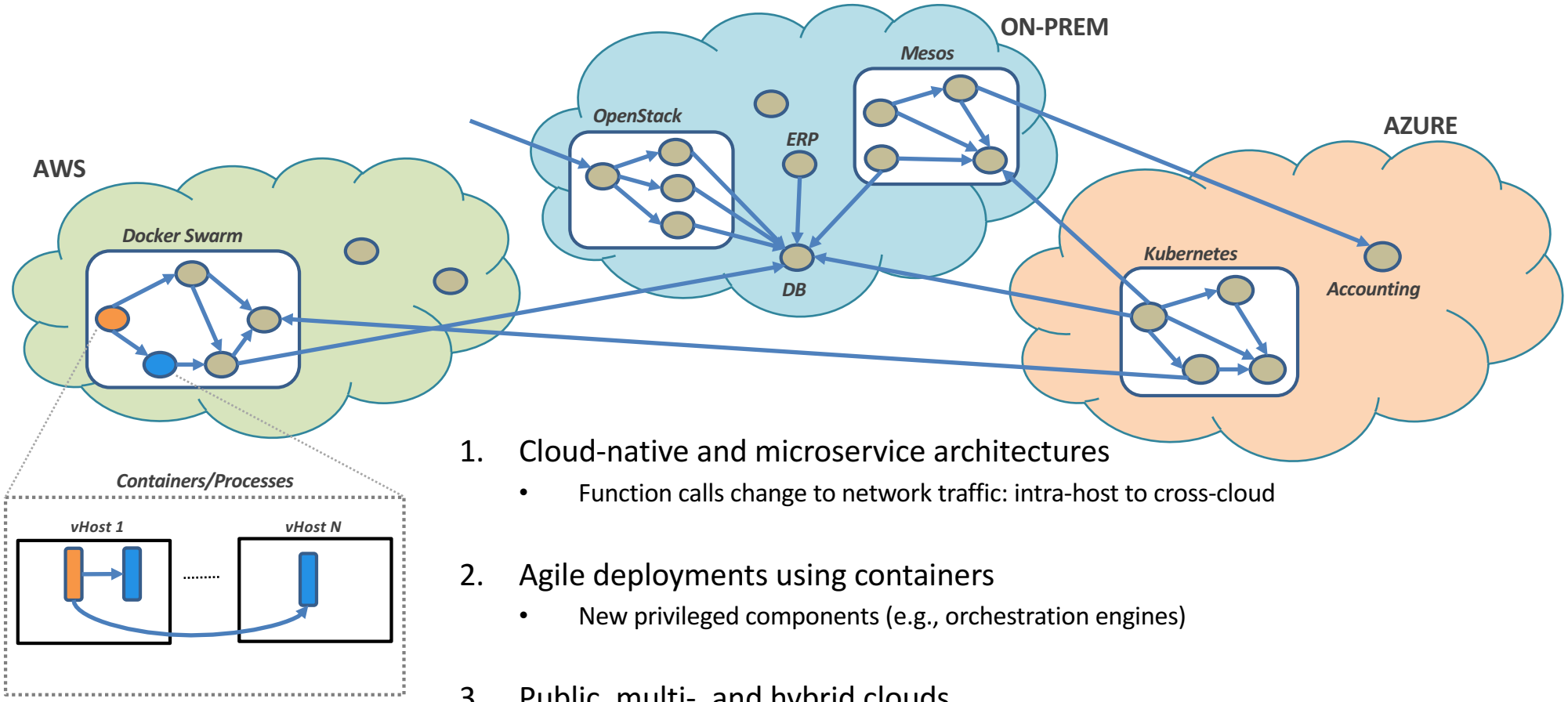
More exposed APIs

New communication channels

Untrusted apps & infrastructure

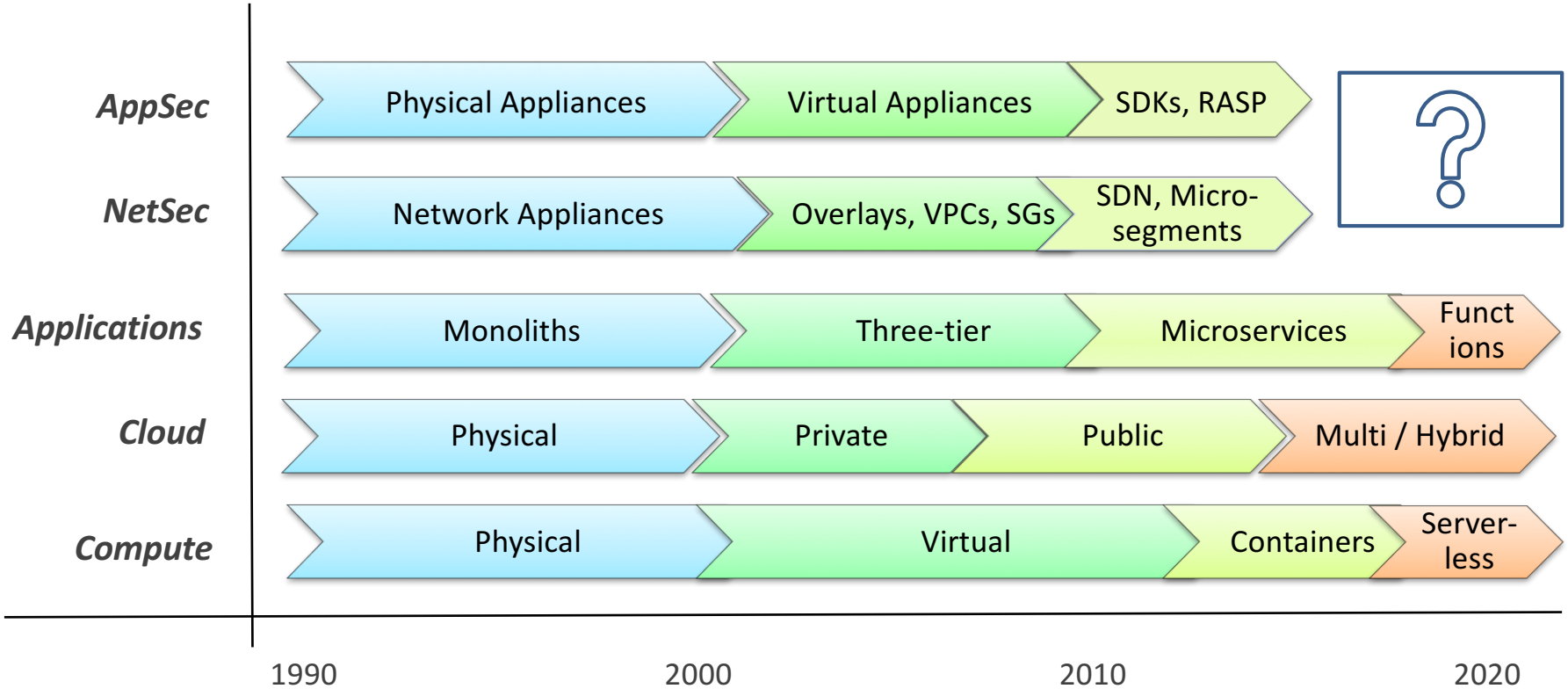


Major IT Trends Put Data at Risk



1. Cloud-native and microservice architectures
   - Function calls change to network traffic: intra-host to cross-cloud
2. Agile deployments using containers
   - New privileged components (e.g., orchestration engines)
3. Public, multi-, and hybrid clouds
   - Lack of global identities, visibility and control

Security Evolution



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Requirements for a Microservices Security Solution

- Addresses new threats
  - Dynamically adapt to the ever-changing workloads
  - Minimal trust in application and infrastructure
  - Distributed and pervasive across clouds
- Works across traditional and modern environments
  - Microservices and traditional applications need to interact
  - Independent of underlying infrastructure
  - Works in polyglot environments
- Ease of use
  - Application-level abstraction, rather than low-level constructs
  - Single pane visibility and control
  - “Set it and forget it” security

Openstack tools

- NetSec
  - Neutron network topologies: provider and tenant networks
  - Virtual routing & firewall-as-a-service: reachability between networks
  - Security Groups: per VIF ingress/egress rulesets based on ip_proto/CIDR:portrange or remote_group_id
  - Role based access control (RBAC): enable different projects to share access to Neutron resources

- AppSec
  - Barbican: secrets store, certificate authority, HSM integration
  - LBaaS plugins: L7 policies using load balancer virtual appliances

Kubernetes tools

- NetSec
  - Network policy: reachability based on pod labels and values
  - Segmentation: provided by some CNI plugins like OpenContrail, Calico
- AppSec
  - Kubernetes secrets management
  - Discussions on service policies

Kubernetes and Openstack

- Deployed Side-by-side
  - Separate OpenStack cluster hosting Nova instances
  - Separate Kubernetes cluster, possibly bare metal
- K8s deployed on OpenStack nova instances
  - Run kube-up.sh for OpenStack – based on OpenStack Heat
  - OpenStack Magnum

Kubernetes & Openstack networking options (over-simplified)

- Independent network frameworks for each cluster
  - OpenStack services exposed through floating IPs, etc.
  - K8s services exposed through external load balancer, or nodeport (static port on all k8s nodes)

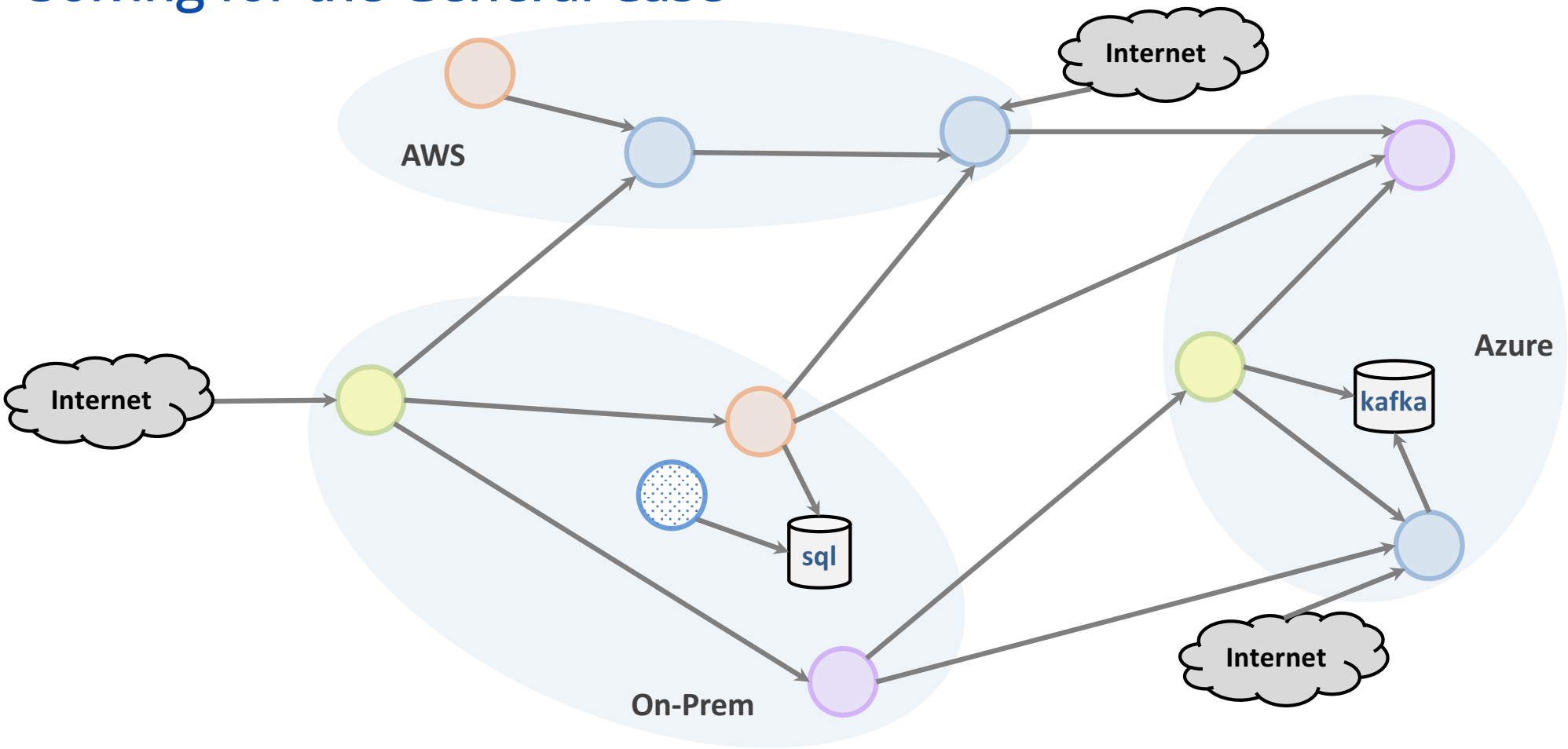
- Project Kuryr: Neutron networks spanning OpenStack & Kubernetes
  - Kuryr controller detects K8s events & allocates Neutron resources
  - Kuryr CNI plugin on each K8s node attaches Neutron resources to K8s pods, integrates with Neutron driver, e.g., openvswitch
  - Result
    - Neutron networks spanning OS & K8s
    - OpenStack security groups on K8s pods
    - OpenStack LBaaS, FWaaS, etc. for k8s services

Kubernetes and Openstack AppSec

- Secrets
  - Separate frameworks for now
  - Even if federated, secrets are problematic
    - Burdens developers and operators
    - May rule out some programming languages or frameworks

- L7 authorization
  - Possible in load balancing solutions
  - Security concerns
    - Lack of application context
    - Requires strict networking controls to avoid evasion

Solving for the General Case



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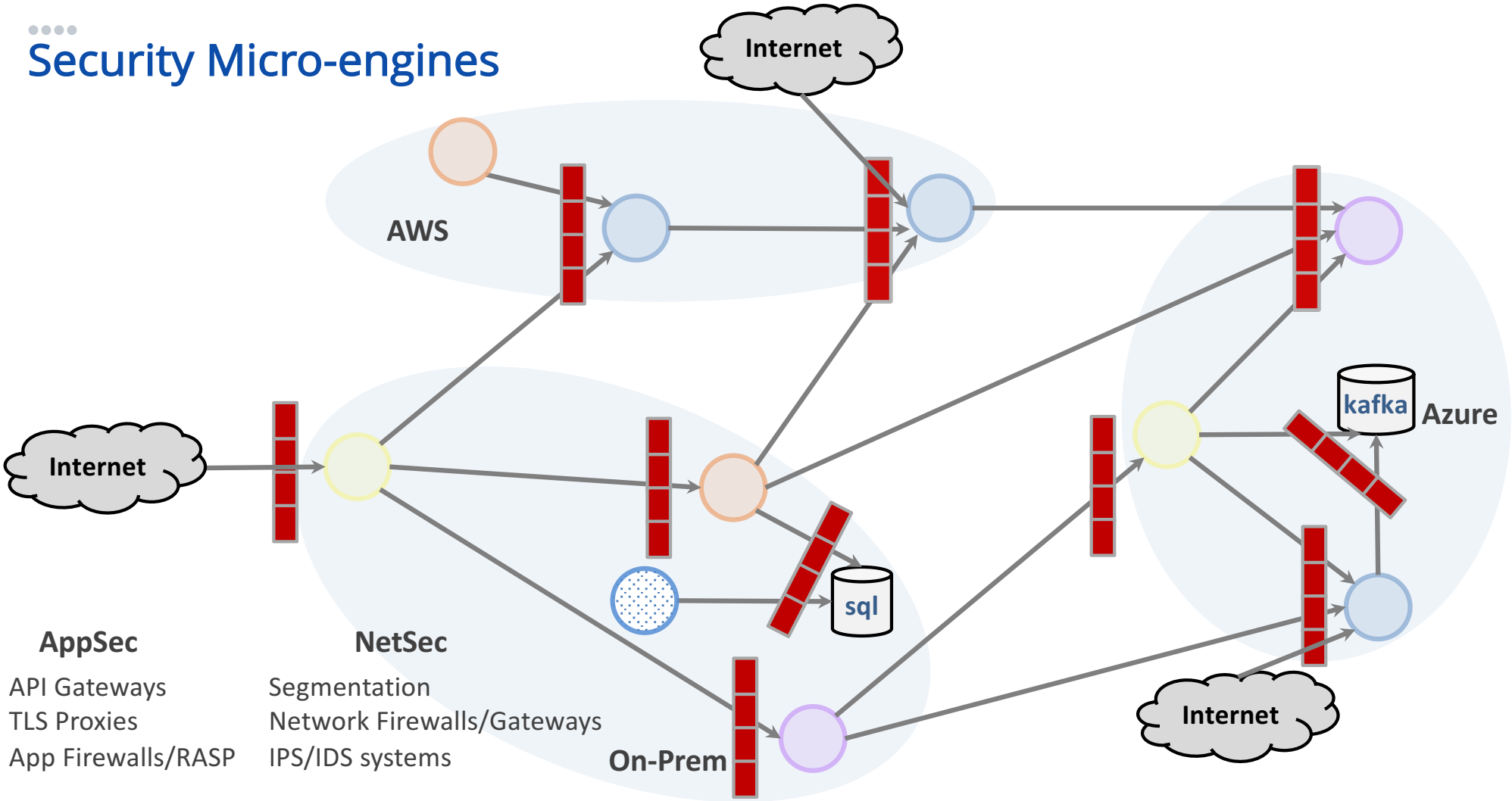
Security Micro-engines



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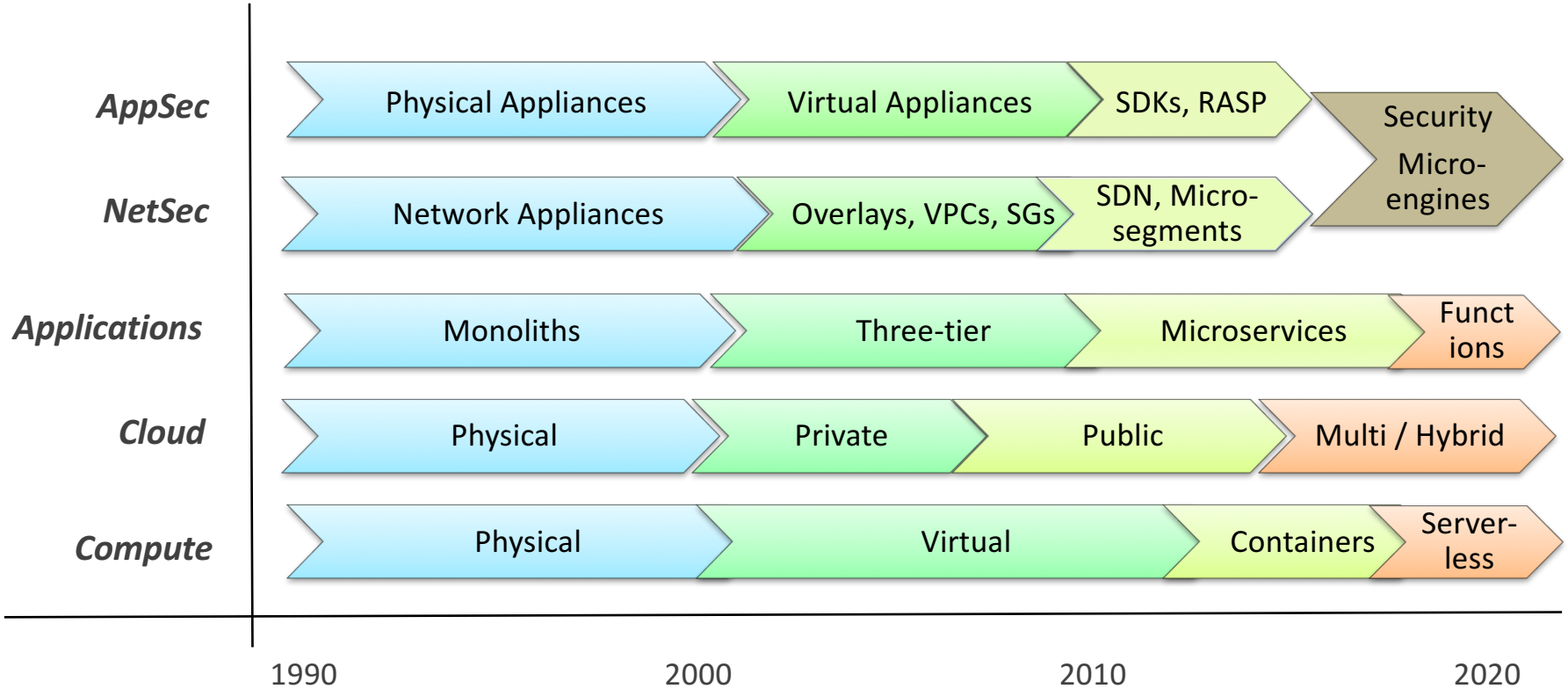
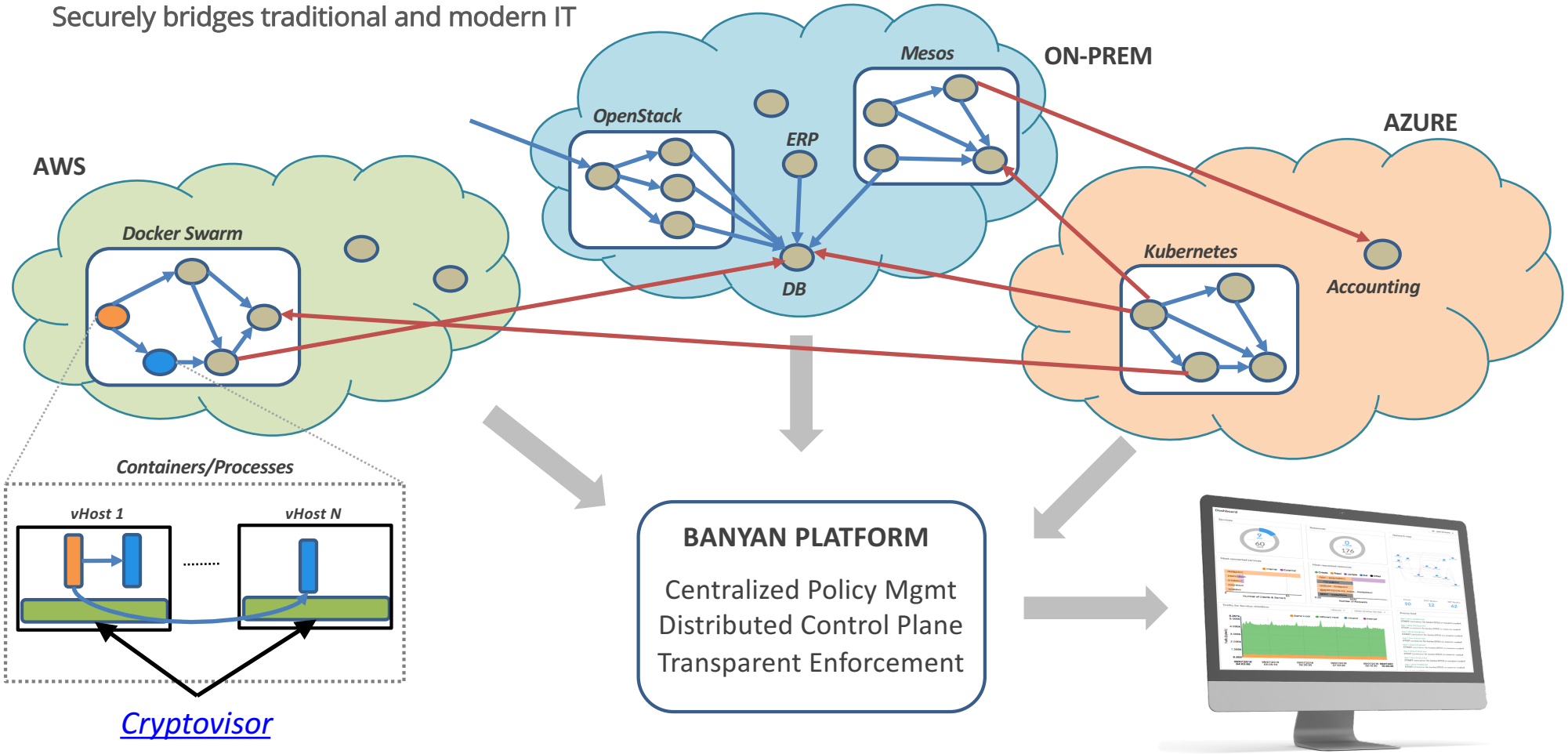
Security Evolution: Convergence of AppSec & NetSec



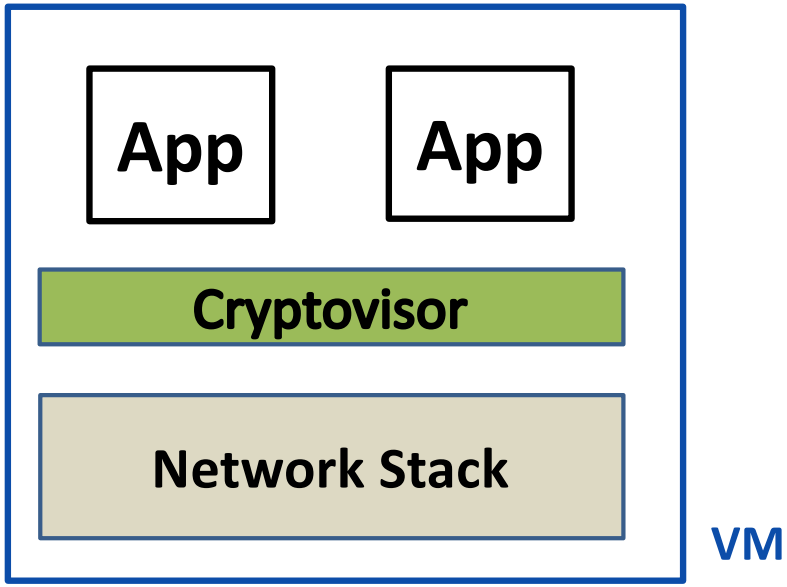
Introducing Banyan Security Micro-engines Platform

Securely bridges traditional and modern IT

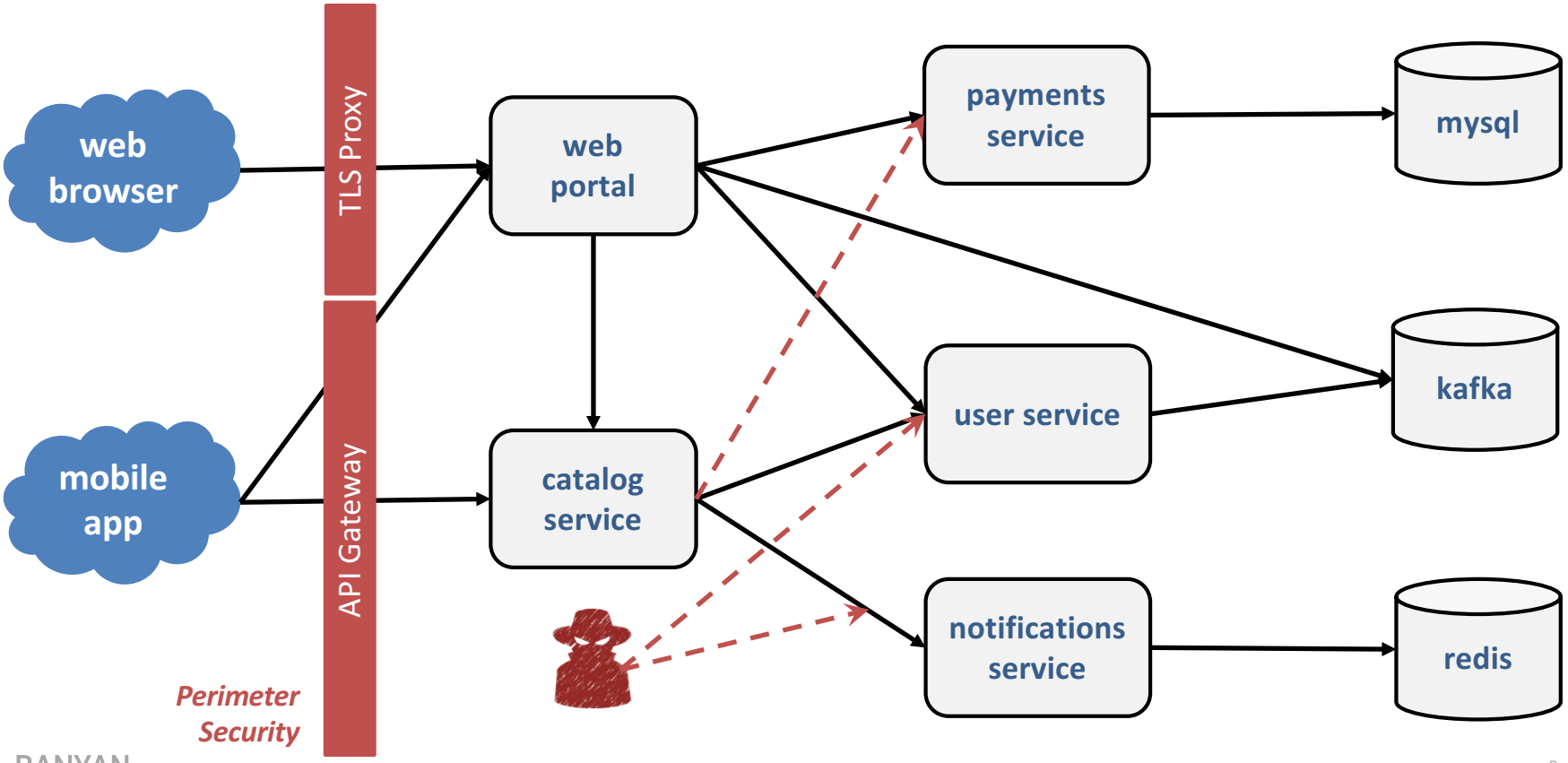


Cryptovisor: Security Virtualization Layer

App-transparent and Network-independent

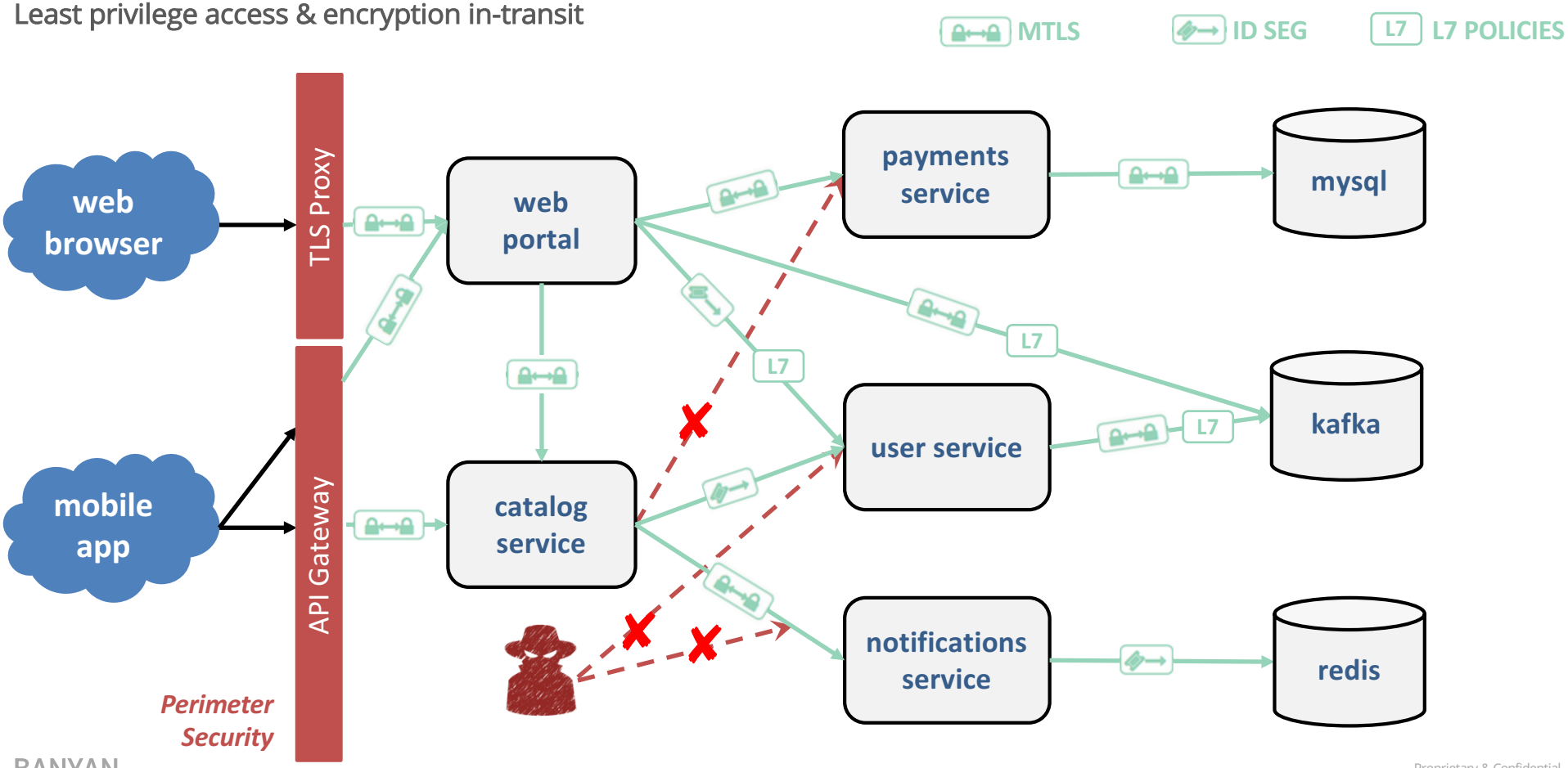


Example application using microservices



Securing inter-service communications

Least privilege access & encryption in-transit



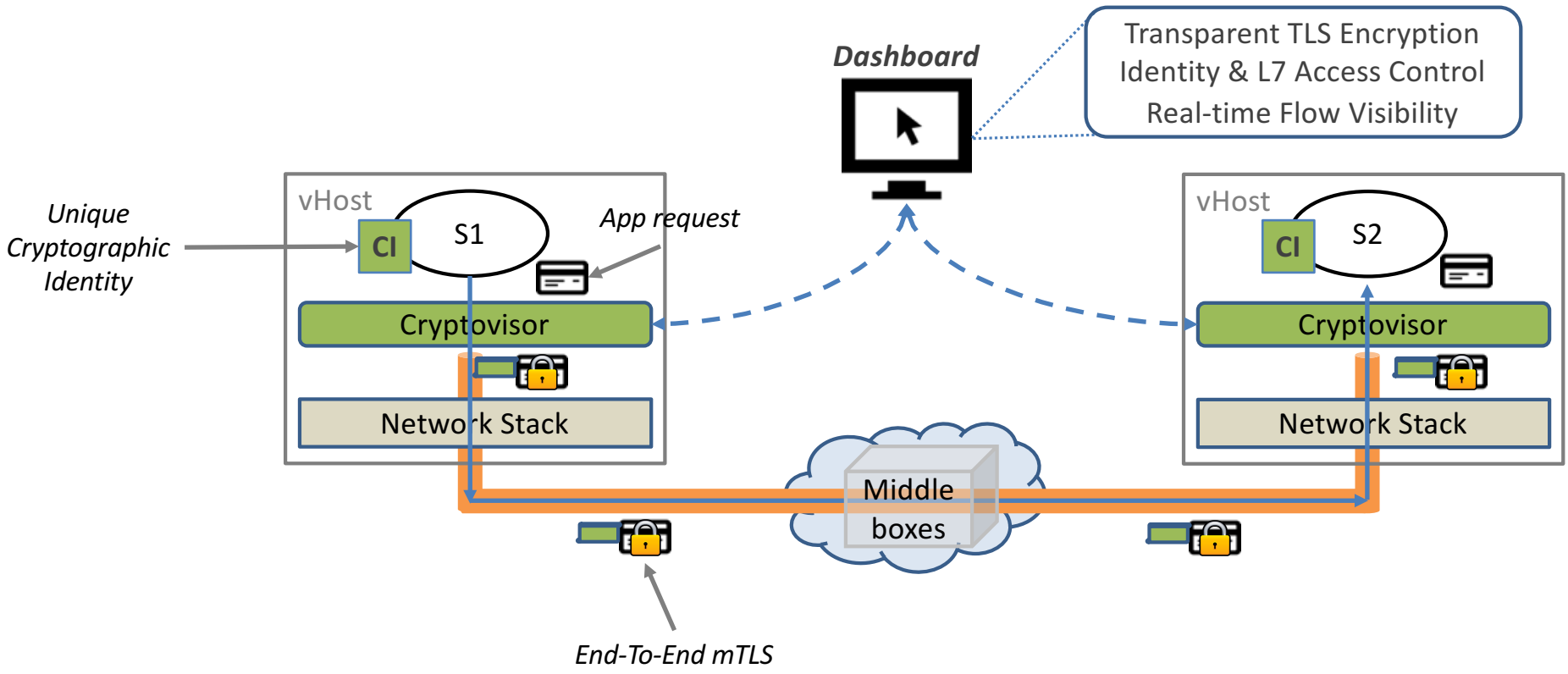
Key attributes

1. **Transparent security layer**
   - No changes to application or infrastructure
   - Works across traditional and modern IT

2. **Global service identity**
   - Cryptography-based (not IP/Port or username/passwd)
   - Cross-cluster, Cross-cloud interoperability

3. **High-performance at the desired level of security**
   - Invoke security functions tailored to each service
   - Set policies using ABAC and RBAC

Security Virtualization Technology



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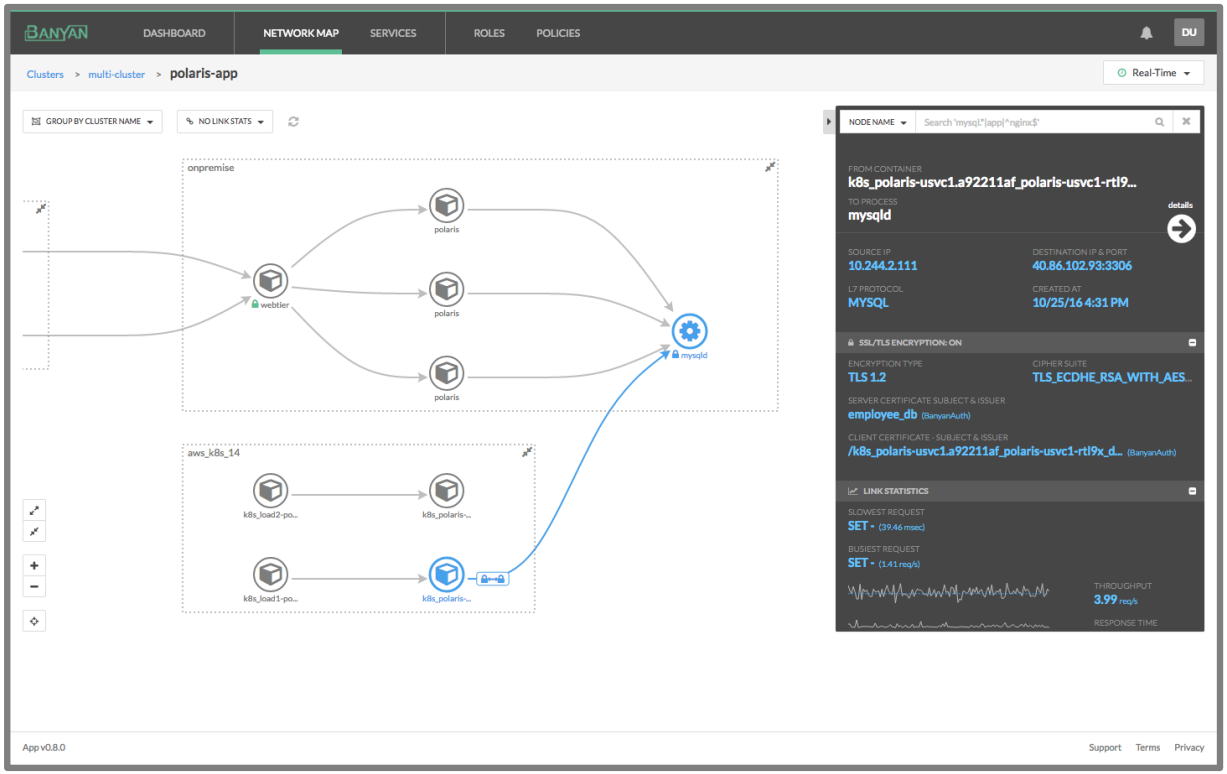
Banyan demo video



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Conclusions and Discussion

- Microservices, Containers, and Hybrid Clouds open up a new attack surface
- Existing security solutions are not designed for such dynamic environments
- New solutions are needed that are:
  - Tailored to microservice architectures
  - Operate at the application layer for identity and access control
  - Works across traditional and modern environments
- Security virtualization technology brings together AppSec and NetSec to protect both modern and traditional applications

Thank You

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