Service mesh for microservices management

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Organizations are adopting microservices for building distributed applications that support agile delivery and scalable deployment, on-premise or in the cloud. However, the rapid adoption comes with its share of challenges. Product development teams should strategize to overcome these challenges while designing a product, and not as an afterthought.

This paper presents strategies to overcome these challenges using an Open Source framework, Istio.

Microservices adoption trends

A survey conducted by NGINX reveals that 70% of organizations are using or exploring microservices. The microservices architecture market is expected to reach $32.01 billion by 2023, growing at a CAGR of around 16.17%. Several large enterprises today are bringing microservices into their mainstream and soon there will be exponential growth across industries.
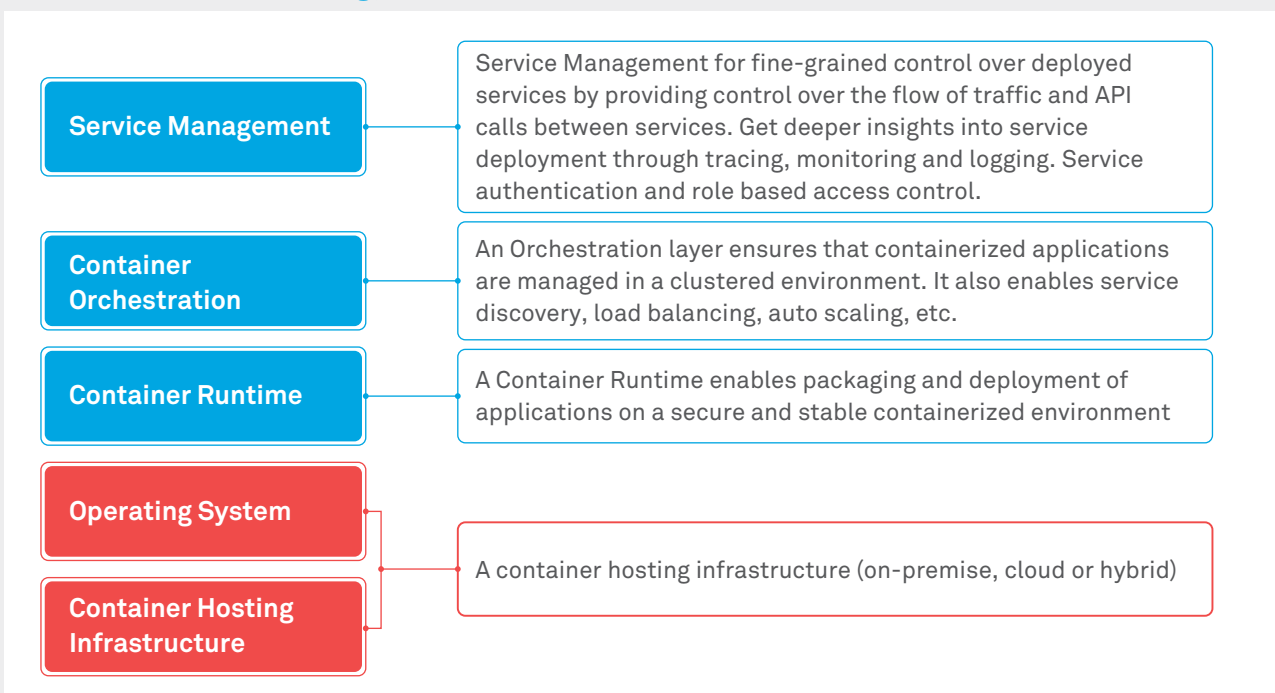
Microservices adoption challenges

The challenges stem from the fact that each application has multiple microservices, multiple versions, multiple instances and perhaps is implemented across different technologies.

This causes:

- **Large component footprint:** The integration of multiple microservices and their API connections adds risks, since each integration is also a potential point of failure

- **Deployment complexity:** Highly distributed, multi-instanced, multi-versioned with complex interactions and more moving parts lead to increased probability of failure

- **Monitoring and tracing service problems:** Due to highly distributed deployment and dynamically scaling services, it becomes a mandate to have a robust runtime monitoring mechanism and maintain a centralized log

- **Service discovery:** Microservices can explode in numbers when multiple instances and versions of services coexist. This necessitates efficient service registry/discovery and traffic routing

- **Security concerns:** With multiple exposed service endpoints, microservices become soft targets for hackers and crackers making it essential to have a robust security mechanism

- **Shift in testing strategy:** Traditional testing strategies may not be effective for microservices applications

Microservices technology stack – orchestration and beyond

Service Management	Service Management for fine-grained control over deployed services by providing control over the flow of traffic and API calls between services. Get deeper insights into service deployment through tracing, monitoring and logging. Service authentication and role based access control.
Container Orchestration	An Orchestration layer ensures that containerized applications are managed in a clustered environment. It also enables service discovery, load balancing, auto scaling, etc.
Container Runtime	A Container Runtime enables packaging and deployment of applications on a secure and stable containerized environment
Operating System	A container hosting infrastructure (on-premise, cloud or hybrid)
Container Hosting Infrastructure	

The challenges stem from the fact that each application has multiple microservices, multiple versions, multiple instances, and perhaps is implemented across different technologies.

Orchestration frameworks like Kubernetes manage container workloads well, but leave out details on how services hosted in the containers talk to each other, and several service level functionalities as seen below.

Orchestration capability	Service level need
Cluster management	Layer 7 traffic routing
Scheduling	Request routing
Service discovery	Circuit breaking
Networking and load balancing	Control over traffic flow among services, transport security (encryption)
Multi-tenant and multi-region	Identity and access control
Simple application health and performance monitoring	Service level telemetry and monitoring
Application deployments	Policy based configurations

Service Management using service mesh – enables better insights and control

Service level control over the traffic flow, configurable traffic routing, detailed telemetry, constant monitoring, graceful handling of failures, strong authentication and access control are needed to enable better insights and control across all services. Benefits of service mesh architecture here will be:

• Uniform observability

• Fine grained traffic control

• Inter service security enablement

• Decoupled functional responsibilities

Various models that support a service mesh pattern are :

Library: Each microservice has a library that includes the service mesh features. Mostly suited if services are written in one language. E.g. Hysterix

Node agent: An agent runs on every node, realizing the service mesh features and can serve varied types of workloads. The technology can be heterogeneous. E.g. Kubelet, Linkerd's mesh

Sidecar: In this pattern there is a sidecar that is attached to the main application, co-locating the related tasks and complementing the main application by providing the supporting service mesh features. E.g. Istio with Envoy, NginMesh with Istio
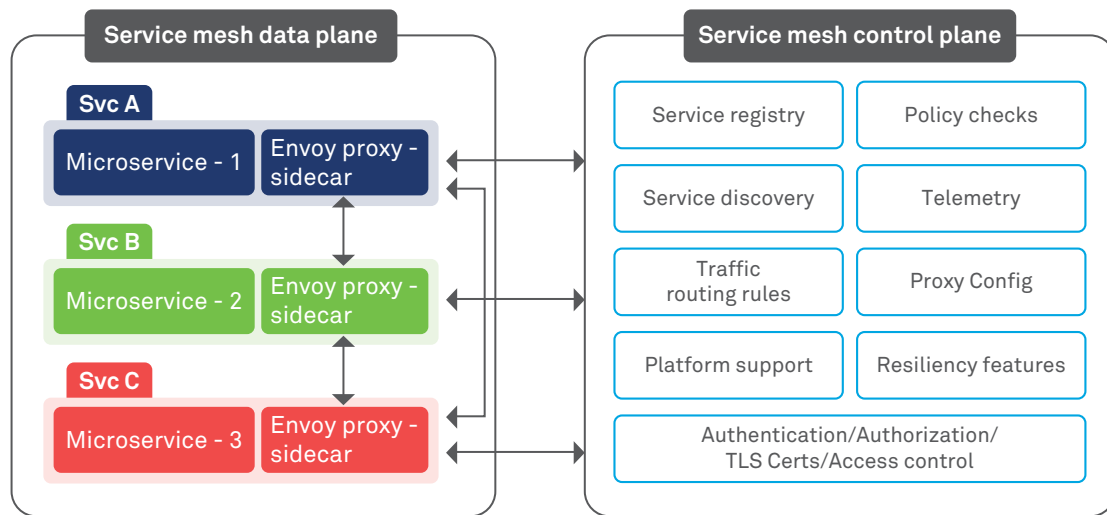
Out of these, the sidecar pattern has some advantages that makes it a preferred choice in certain frameworks.

- The sidecar supports a heterogeneous set of languages and frameworks

- The sidecar extends the services with absolutely no changes to the main service code
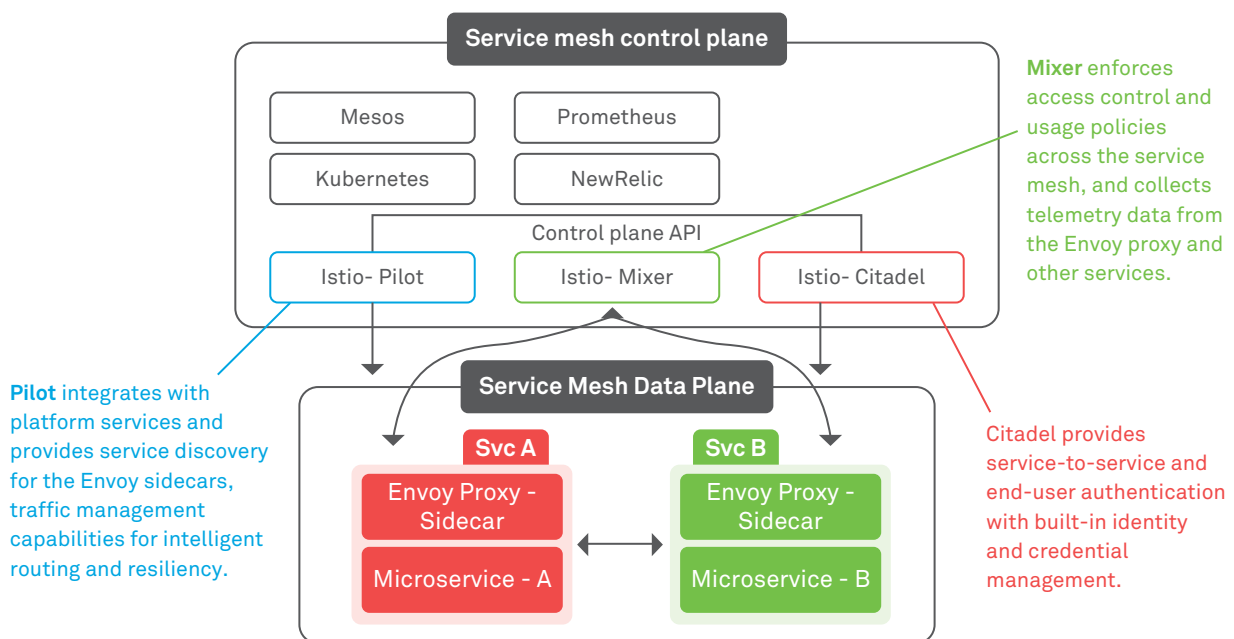
- No impact on the communication latency

Service Management through Istio service mesh

Istio, created by Google, IBM and Lyft, is a service mesh that provides behavioural insights and operational control over the service mesh using (a) a data plane and (b) a control plane (refer to the diagram below).

Service mesh data plane

- Svc A
  - Microservice - 1
  - Envoy proxy - sidecar
- Svc B
  - Microservice - 2
  - Envoy proxy - sidecar
- Svc C
  - Microservice - 3
  - Envoy proxy - sidecar

Service mesh control plane

- Service registry
- Policy checks
- Service discovery
- Telemetry
- Traffic routing rules
- Proxy Config
- Platform support
- Resiliency features
- Authentication/Authorization/ TLS Certs/Access control

The service mesh data plane is composed of a set of intelligent proxies (Envoy, an Open Source high performance edge proxy) deployed as sidecar containers to the main service. These proxies mediate and control all network communication between microservices, and enable traffic control, extraction of insights for the traffic behaviour, service discovery, health checking, routing, load balancing, authentication/authorization, and observability.

The service mesh control plane manages and configures the proxies to route traffic. Thus, it manages the overall network infrastructure, enforces policy, traffic rules for routing, collect telemetry and configuration for the entities running data plane.

Service mesh control plane

- Mesos
- Prometheus
- Kubernetes
- NewRelic
- Control plane API
- Istio- Pilot
- Istio- Mixer
- Istio- Citadel

Service Mesh Data Plane

- Svc A
  - Envoy Proxy - Sidecar
  - Microservice - A
- Svc B
  - Envoy Proxy - Sidecar
  - Microservice - B

Mixer enforces access control and usage policies across the service mesh, and collects telemetry data from the Envoy proxy and other services.

Pilot integrates with platform services and provides service discovery for the Envoy sidecars, traffic management capabilities for intelligent routing and resiliency.

Citadel provides service-to-service and end-user authentication with built-in identity and credential management.

Wipro's capabilities and accelerators

The Scalable Platform Engineering team in Wipro has developed microservices based products and platforms across industries. We help customers accelerate development of microservices based applications, with our capabilities such as:

- Orchestration Framework for automating deployment, scaling, and management of containerized applications

- Foundational Microservice Enabler Platform built by integrating the Scalable Orchestration Framework and Istio, which are enabled for Cloud and On-premise deployments

- Specialized services, which include architectural consulting, technology modernization, cloud native and cloud neutral microservices application building expertise and DevOps pipeline

- Readily available trained, skilled and experienced resource pool on microservices, container technologies and tools.

Conclusion

Organizations, using microservices strategy for product modernization and new product development, can benefit by adopting a service mesh framework, like Istio. Wipro, with its deep expertise and IP, is excited to work with organizations on their journey of microservices adoption, and deliver great products with faster time to market and reduced costs.

About the authors

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Roopa has 17 years' experience in Product Engineering and Microsoft Technologies. She has expertise in delivery, pre-sales and solution development of enterprise and system level software across industry domains. She is currently handling key initiatives around scalable platforms and providing solutions in product development, product modernization and product sustenance areas.

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