Overview of Distributed Architecture for Microservices Communication (DAMC)

[draft-li-icnrg-damc]

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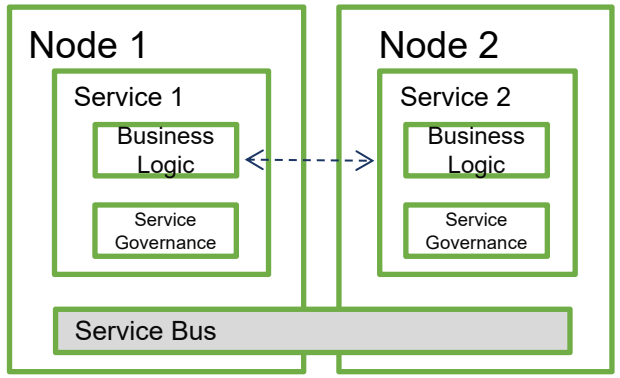
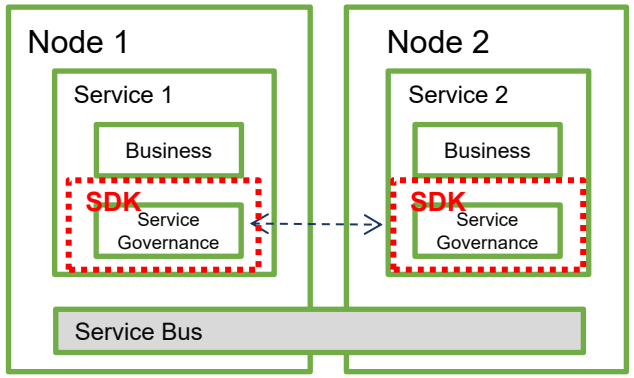
Service Mesh Concepts & Challenges

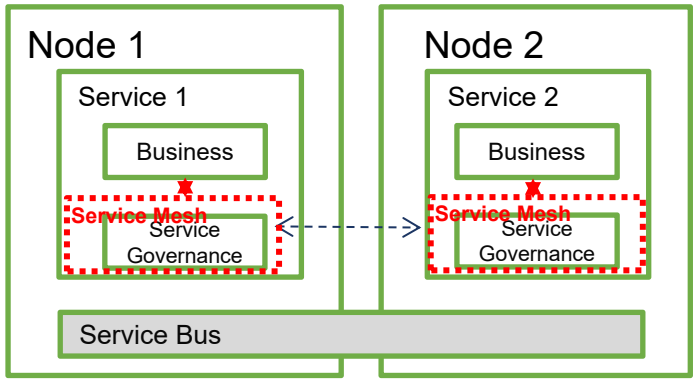
Service Mesh: Dedicated infrastructure layer for handling service-to-service communications



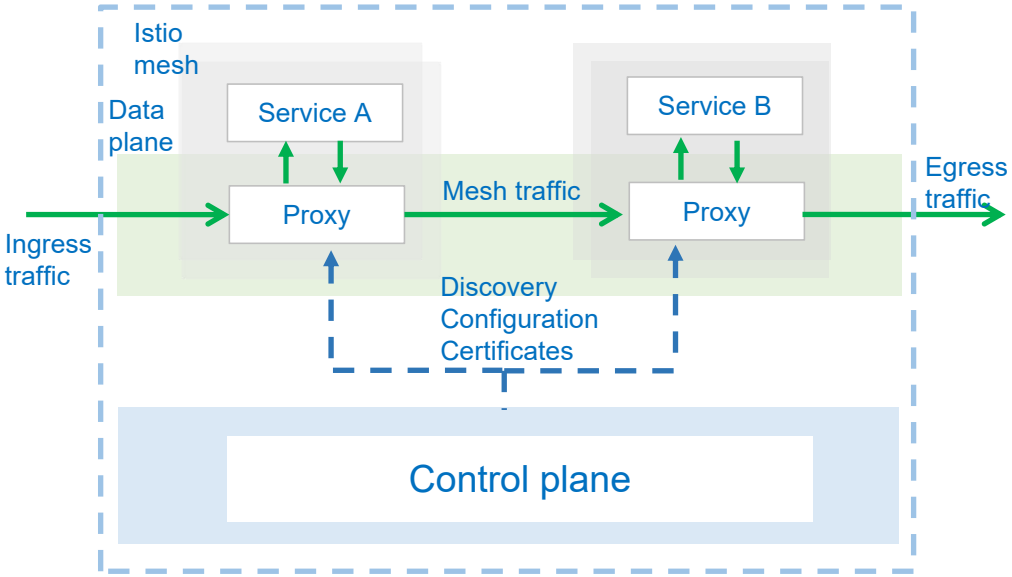
1: Service governance capabilities embedded in business code



2: Unify service governance capabilities to SDK implementation



3: Unifying Service Governance Capabilities to the Service Mesh



4: Istio service Mesh with centralized control plane

Challenges

1. **Concentrating all traffic through proxies**
2. **Single point of failure risk**
3. **Complex Communication demanding**

Motivations

- Considering the above challenges, and China Telecom's 27.1% year-on-year growth in the cloud services market, we require an **innovative solution** that:

  - Adapt to the continually growing demands of microservices communication.
  - Feature end-to-end service telemetry capabilities
  - Provide robust mechanisms
  - Offer flexible scheduling capabilities
  - Support information-centric communication

Importance of DAMC

- **DAMC:** Distributed Architecture for Microservices Communication
  --**Purpose: Enhance microservice communication efficiency and reliability**

Content-Centric:
- prioritize content and services

Decentralization:
- distribute processing and storage capabilities

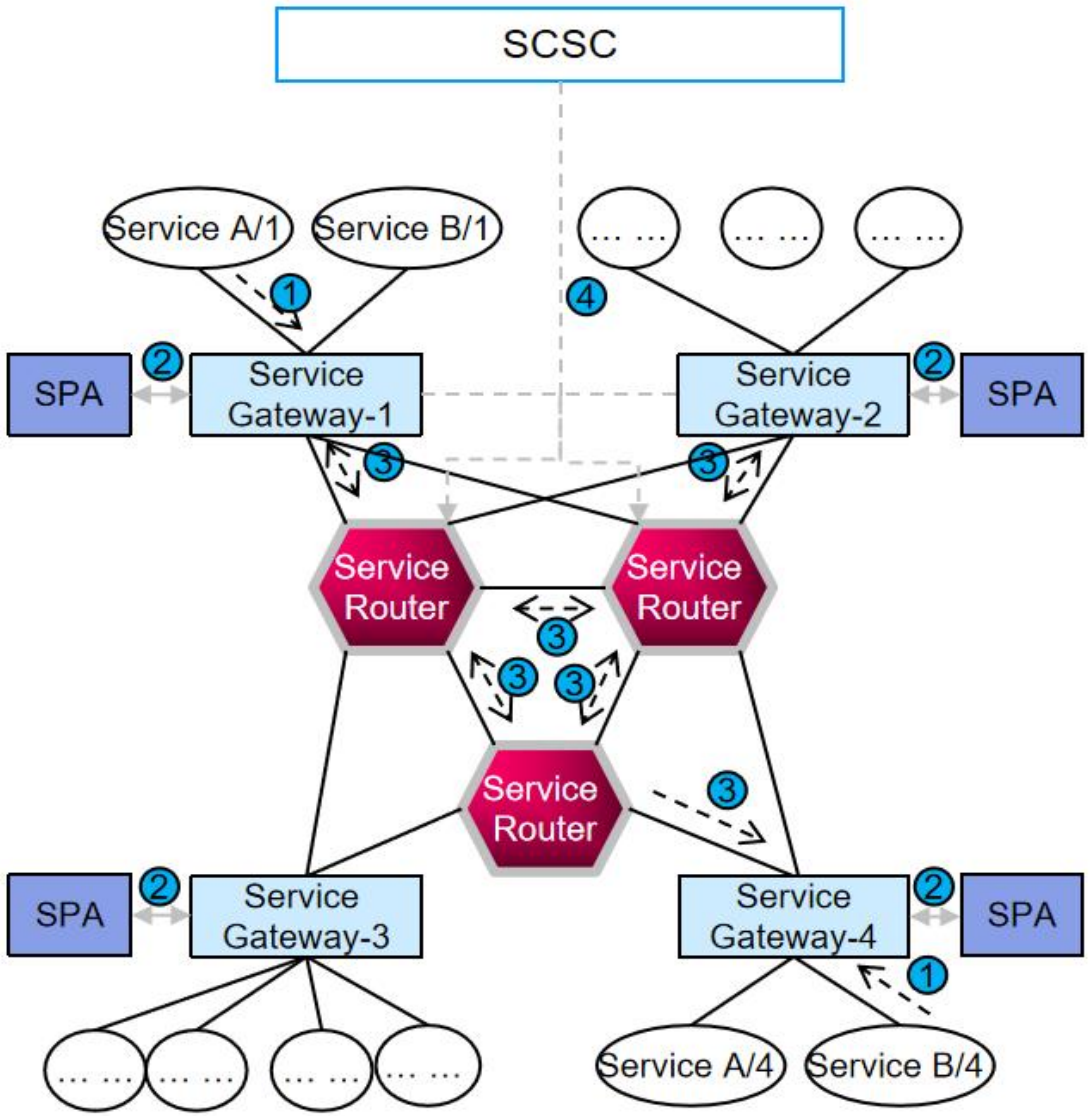
Dynamic Resource Allocation:
- optimize resource allocation
- enhancing network efficiency

Scalability and Flexibility:
- accommodate the evolving demands of the network

Distributed Architecture for Microservice Communication

- **Components:**
  - **Service Gateway (SG):**
    manages and controls communication traffic.
  - **Service Router (SR):**
    Optimizes routing based on Prefix and topology.
  - **Service Prefix Authentication (SPA):**
    Validates Prefix usage by microservices.
  - **Service Mesh Communication Scheduling Center (SCSC):**
    Assist in optimizing communication policies.

- **Benefits:**
  - **Decentralized routing decisions** via SG and SR.
  - **Routing Optimization** based on SCSC.
  - **Enhanced security** via Prefix authentication.



Control signaling messages of DAMC

- The types and functions of control signaling messages required for communication between components:

Type	Communication Entities	Control Signaling Message Types	Control Signaling Function
1	Pod/SG	Service Prefixes (Name Space) Announcement	Microservices within each Pod communicate their used Service Prefix (Namespace) to the SG.
2	SG/ SR	Service Prefixes LSA	SG and SR advertise the Service Prefix and topology link relationship they can reach.
3	SG/SPA	Service Prefixes Authentication	The SG authenticates to the SPA requested by the Pod is legal.
4	SG /SR and SCSC	Service QoS Telemetry/Service QoS Policy	Communication quality reporting policies between microservices.

Control and forwarding processes in DAMC

1- Service Prefix Announcement

- Microservices notify their unique service prefixes to connected Service Gateways (SG).

2- Service Prefix Authentication

- SG (e.g., SG-1) verifies service prefixes through Service Prefix LSA.

3- Topology Announcement

- SG (e.g., SG-1) uses SPA signaling to communicate with Service Routers (SR).

4- Network-Wide Notification

- Other microservices and SGs adopt similar processes for notification.

5- Link State Database (LSDB) and Routing

- SG interacts with SR to generate LSDB with received Service Prefix LSAs.
- FIB guide traffic forwarding and routing for optimal path selection.

Control plane

Forwarding plane

Initiating Communication

- Service A sends a communication request to Service B.
- SG-A processes communication request from Service A.

Communicating through Service Gateways

- SG-A performs service prefix authentication on it and distributes it to SR after passing it
- SR forwards the request data packet based on forwarding information base.

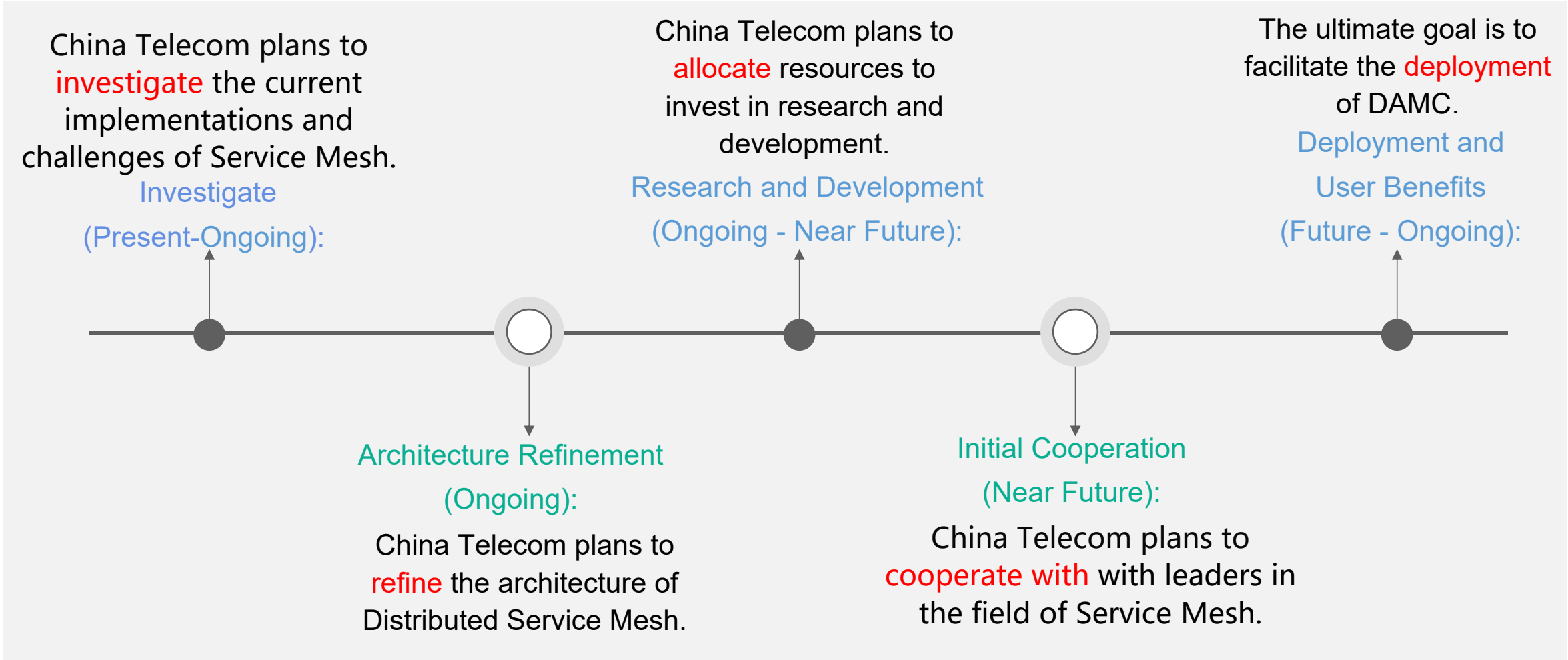
Final Destination

- SR routes the request data packet to the destination microservice SG-B.
- SG-B processes the request and directs it to the service B.

Comparison between DAMC and Istio service mesh

	DAMC	Istio Service Mesh
Type	Microservice Communication Solution Supporting Information-Centeric Network	Standalone Service Mesh (Open Source Project)
Communication Architecture	Highly Distributed	Highly Distributed
Traffic Management	Managed through Service Gateways and Service Routers	Managed through Envoy Proxy
Routing Decisions	Optimized through Service Routers	Supports various routing policies, Configurable
End-to-End Service Assurance	Yes	Yes
Prefix Authentication (SPA)	Yes	No
Management and Configuration	Highly Configurable	Configurable
Deployment and Maintenance	Customized, Requires Development Work	Open Source, Community Supported
Scalability	High	Moderate
ICN supported	Yes	No
Automatic Sensing and Adjustment	Yes	Partially Supported

Development considerations for DAMC



DAMC References

- **RFC 8793:** Information-Centric Networking (ICN): Content-Centric Networking (CCNx) and Named Data Networking (NDN) Terminology
- **ICN:** A survey of information-centric networking
- **Microservices:** Microservices: yesterday, today, and tomorrow
- **ServiceMesh:** Service mesh: Challenges, state of the art, and future research opportunities
- **microservice:** Guiding architectural decision making on service mesh based microservice architectures
- **SOA:** "Implementation Issues and Challenges of Service Oriented Architecture" , https://eprints.bournemouth.ac.uk/14267/1/Masters_Dissertation_SOA.pdf
- **Istio:** Impact of etcd deployment on kubernetes, istio, and application performance
- **NDN:** Named Data Networking

Comments ➡

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5G hello

Thank you!