Overview of Distributed Architecture for Microservices Communication (DAMC)

[draft-li-icnrg-damc]

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**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

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

**Decentralization**:
- distribute processing and storage capabilities

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

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

Control plane

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

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.

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.

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.

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

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

China Telecom plans to investigate the current implementations and challenges of Service Mesh.

Investigate (Present-Ongoing):

Architecture Refinement (Ongoing):
China Telecom plans to 
refine the architecture of Distributed Service Mesh.

China Telecom plans to allocate resources to 
invest in research and development.

Research and Development (Ongoing - Near Future):

Initial Cooperation (Near Future):
China Telecom plans to cooperate with leaders in the field of Service Mesh.

The ultimate goal is to facilitate the deployment of DAMC.

Deployment and User Benefits (Future - Ongoing):
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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Thank you!