# METRICS BASED COMPARISON AND PERFORMANCE EVALUATION OF SOA AND MICROSERVICES


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# PROBLEM STATEMENT

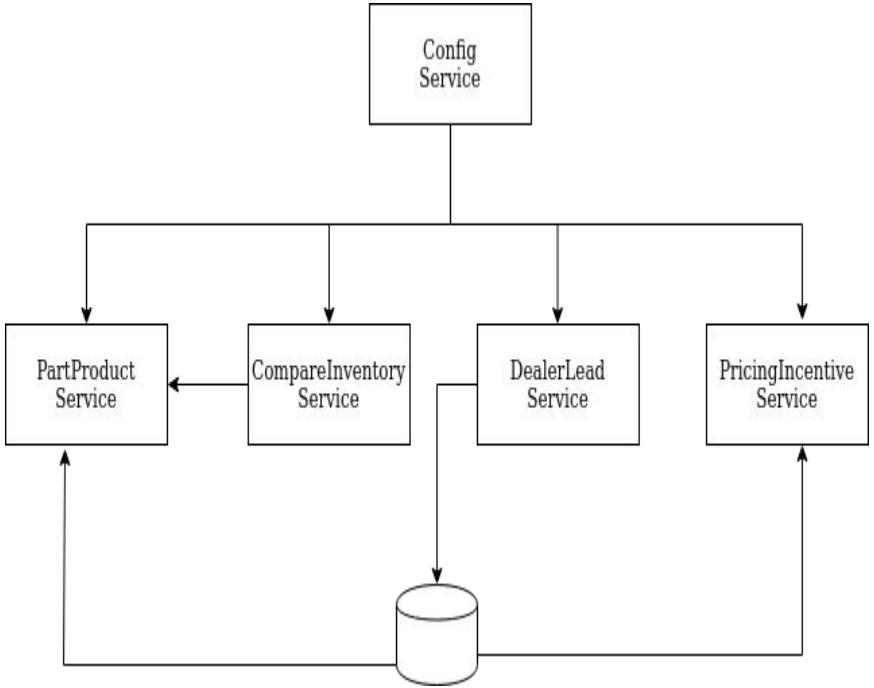
- A systematic mapping study conducted by Taibi D *et al.* stated the open issues and research gaps in the emerging topic of microservices architecture **[1]**.
- Among the emerging issues highlighted, comparison of both service oriented architecture and microservices is one which we have selected. There is a lack of comparison between these two architectures in terms of performance, coupling , development effort and maintenance.
- In this work, we choose to compare both the styles with loose coupling first and then we compare them in terms of performance.

# IMPLEMENTATION

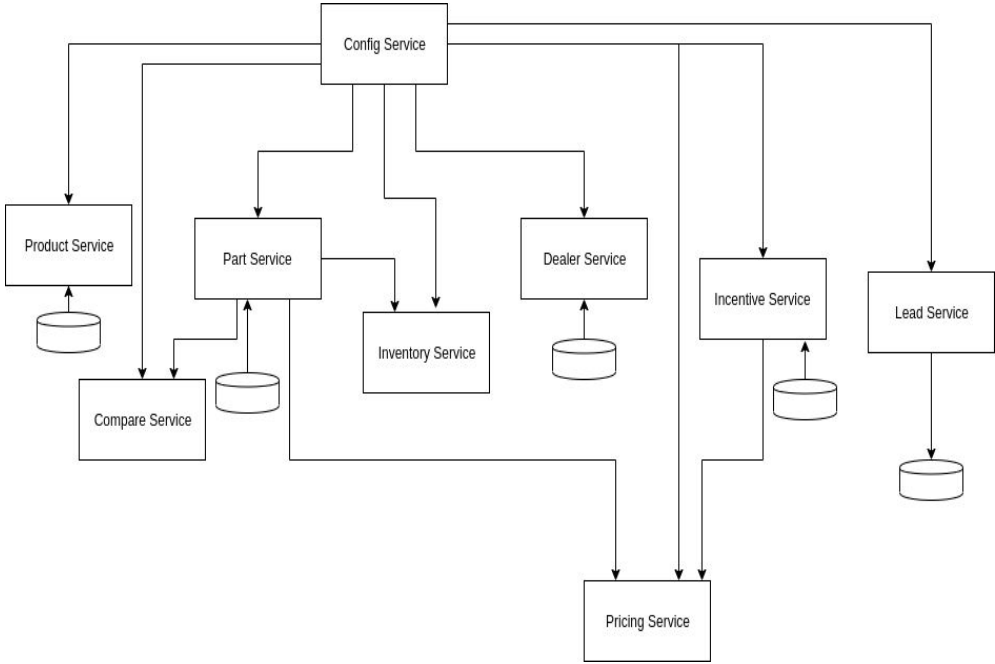
- A Retail Vehicle Application**[4]** is considered for comparing both the architectures.
- It is implemented in SOA and Microservices architectures using Spring Boot.
- JAR file of each service is containerised
- Each **Docker** container represents a service
- The application created in both the architecture styles is tested under a load of 1000 users and their response time is compared using **JMeter**

# ARCHITECTURE

## SOA Application




## Microservice Application



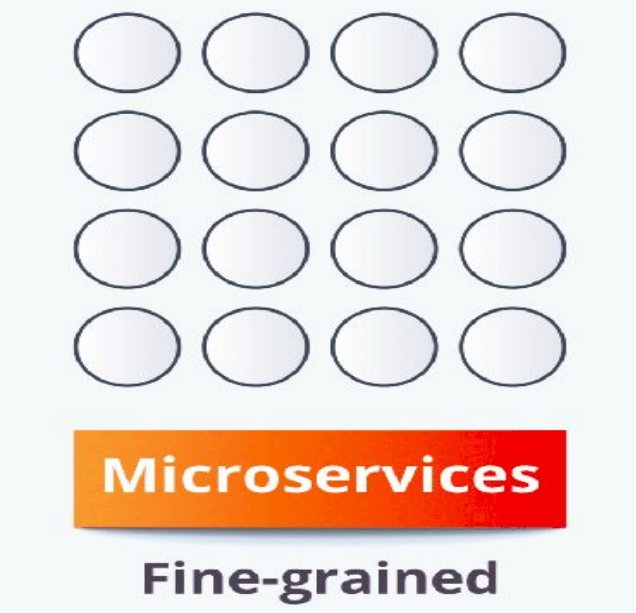
## SERVICE ORIENTED ARCHITECTURE

1. Applications make use of services available in the network
2. Follows "**share-as-much-as-possible"** architecture approach
3. Maximises application service reusability
4. Services share data storage

## MICROSERVICE ARCHITECTURE

1. Large application made up of fine grained services
2. Follows **"share-as-little-as-possible"** architecture approach
3. Focuses on decoupling
4. Services have their own data storage

# SOA VS MICROSERVICES

# PERFORMANCE TESTING

- Apache **JMeter™** application is used for load testing.
- It is an open source software, a 100% pure Java application designed to load test functional behavior and measure performance.
- It uses threads for calling API of the services.
- Each thread corresponds to a single user.

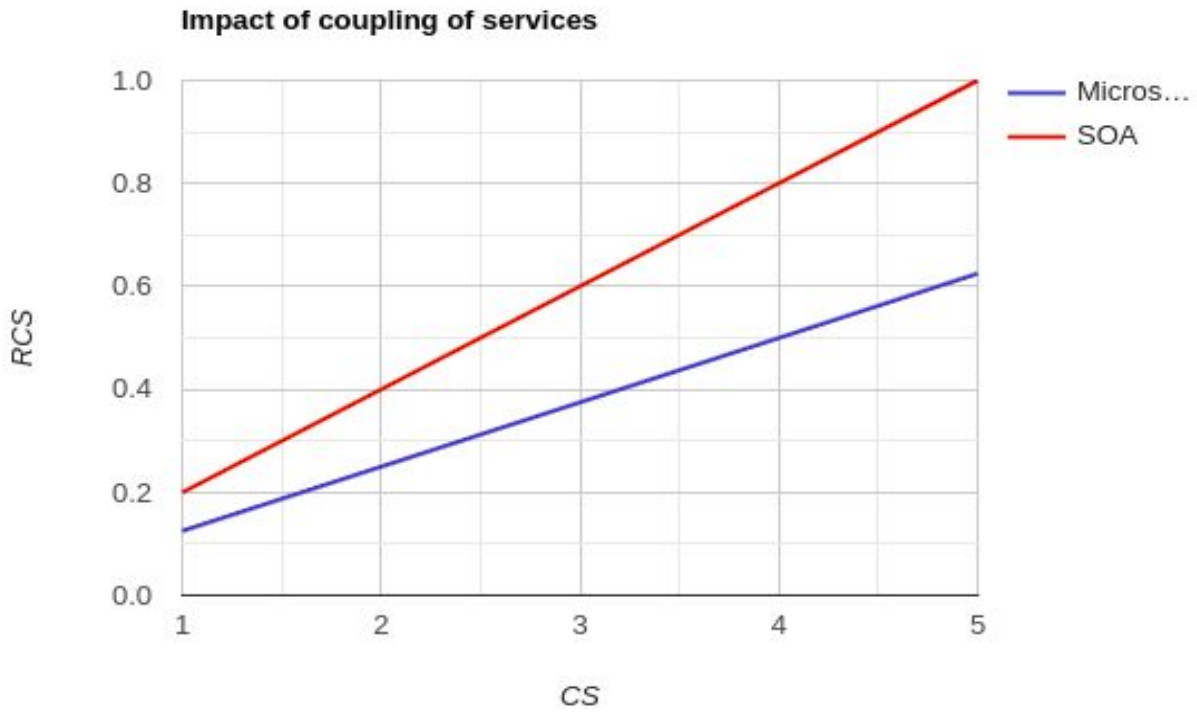
## Coupling in SOA

| Service# | Service Name | Interacting Service# | CS Value | RCS Value |
|---|---|---|---|---|
| 1 | Config Service | 2,3,4,5 | 4 | 0.8 |
| 2 | PartProduct Service | 1,2,5 | 3 | 0.6 |
| 3 | PricingIncentive Service | 1 | 1 | 0.2 |
| 4 | DealerLead Service | 1 | 1 | 0.2 |
| 5 | CompareInventory Service | 1,2 | 2 | 0.4 |

## Coupling in Microservice Architecture

| Microservice # | Microservice Name | Interacting Service # | CS Value | RCS Value |
|---|---|---|---|---|
| 1 | Config Service | 2,3,4,5,6,7,8,9 | 8 | 0.88 |
| 2 | Part Service | 1,4,8 | 3 | 0.33 |
| 3 | Product Service | 1 | 1 | 0.11 |
| 4 | Compare Service | 1,2 | 2 | 0.22 |
| 5 | Incentive Service | 1,6 | 2 | 0.22 |
| 6 | Pricing Service | 1,5 | 2 | 0.22 |
| 7 | Dealer Service | 1,9 | 2 | 0.22 |
| 8 | Inventory Service | 1,2 | 2 | 0.22 |
| 9 | Lead Service | 1,7 | 2 | 0.22 |

# COMPARISON OF COUPLING OF SERVICES

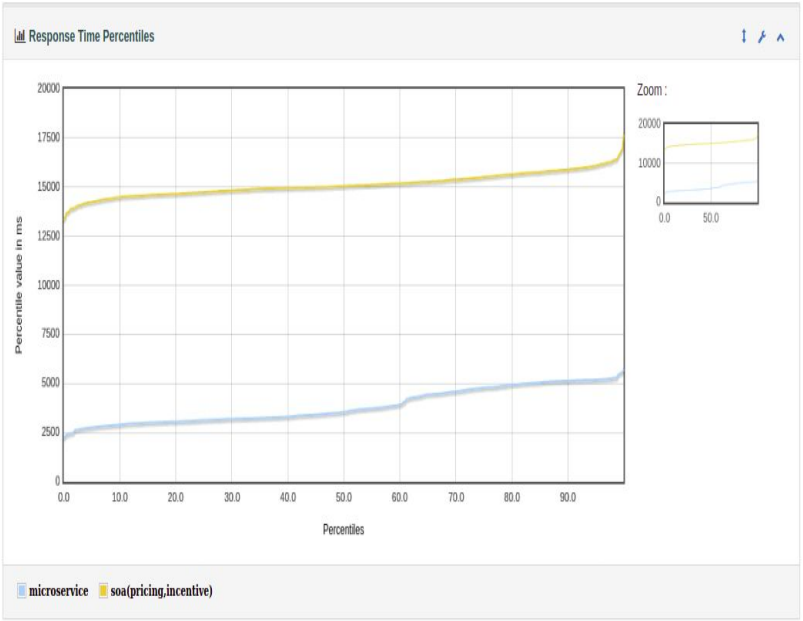


# COMPARISON OF RESPONSE TIME

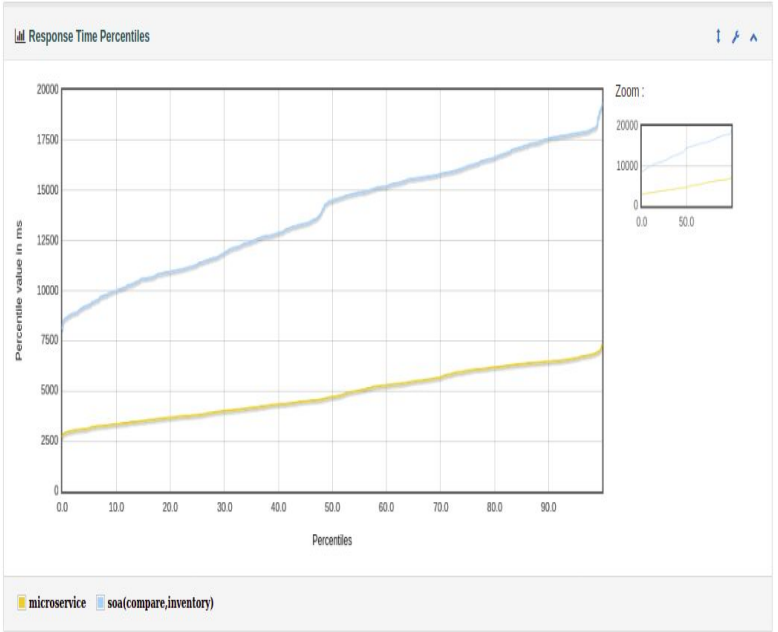
| Service # | Service Name | Response Time(ms) (Microservice) | Response Time(ms) (SOA) |
|---|---|---|---|
| **1** | PartProduct Service | 4813.69 | 8080.58 |
| **2** | PricingIncentive Service | 3870.91 | 15127.50 |
| **3** | DealerLead Service | 4037.32 | 16199.60 |
| **4** | CompareInventory Service | 4866.44 | 13887.48 |

- From the above table, we conclude that Microservices application performs better than SOA application in terms of Response Time

# COMPARISON OF RESPONSE TIME




PricingIncentive Service

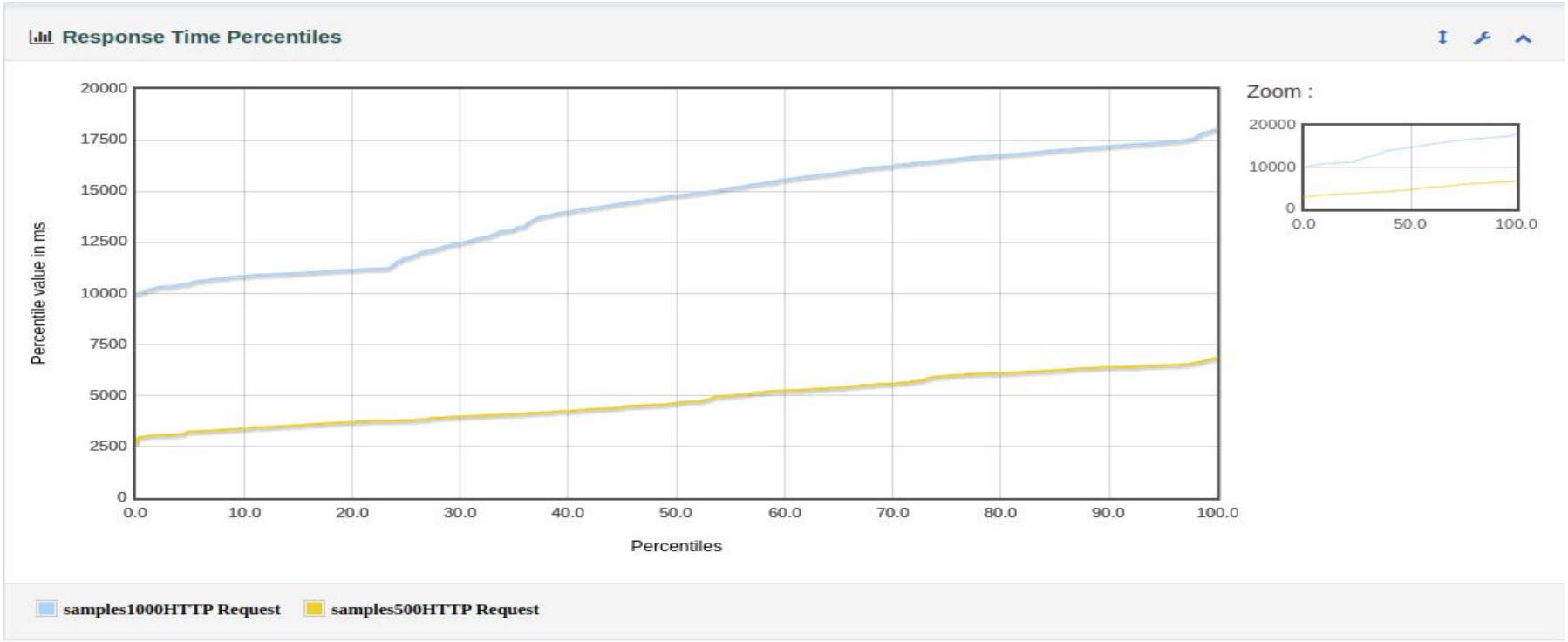



CompareInventory Service

# RESPONSE TIME UNDER DIFFERENT LOAD CONDITIONS

| Microservice # | Microservice Name | Response Time(ms) (500 samples) | Response Time(ms) (1000 Samples) |
|---|---|---|---|
| **1** | Part Service | 4245.85 | 14590.98 |
| **2** | Product Service | 5381.52 | 6712.26 |
| **3** | Compare Service | 4818.51 | 14296.40 |
| **4** | Incentives Service | 3133.11 | 3481.54 |
| **5** | Pricing Service | 4914.38 | 9608.29 |
| **6** | Dealer Service | 4608.70 | 5398.62 |
| **7** | Inventory Service | 4403.81 | 3783.48 |
| **8** | Lead Service | 3671.6 | 10303.73 |

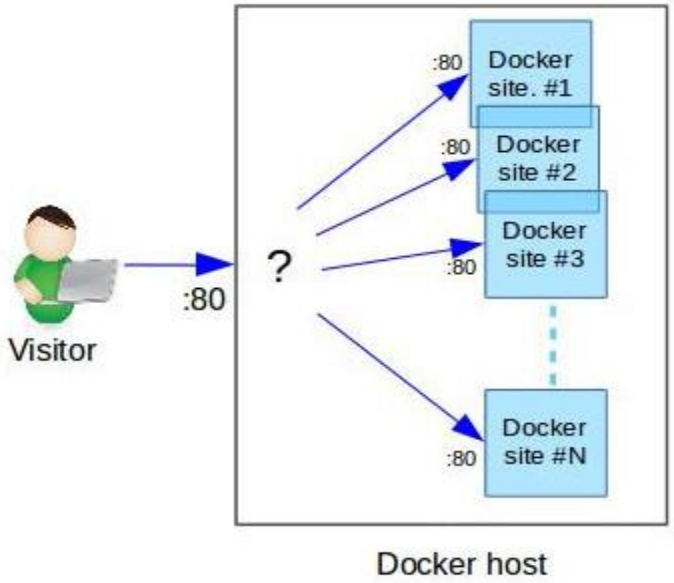
# RESPONSE TIME UNDER DIFFERENT LOAD CONDITIONS IN MICROSERVICE ARCHITECTURE



# RESPONSE TIME UNDER DIFFERENT LOAD CONDITIONS

- We observe that response time increases with increase in number of users
- We need a solution such that the performance should be improved under different load
- Running multiple instances of the microservices achieves this.

# MULTIPLE INSTANCES



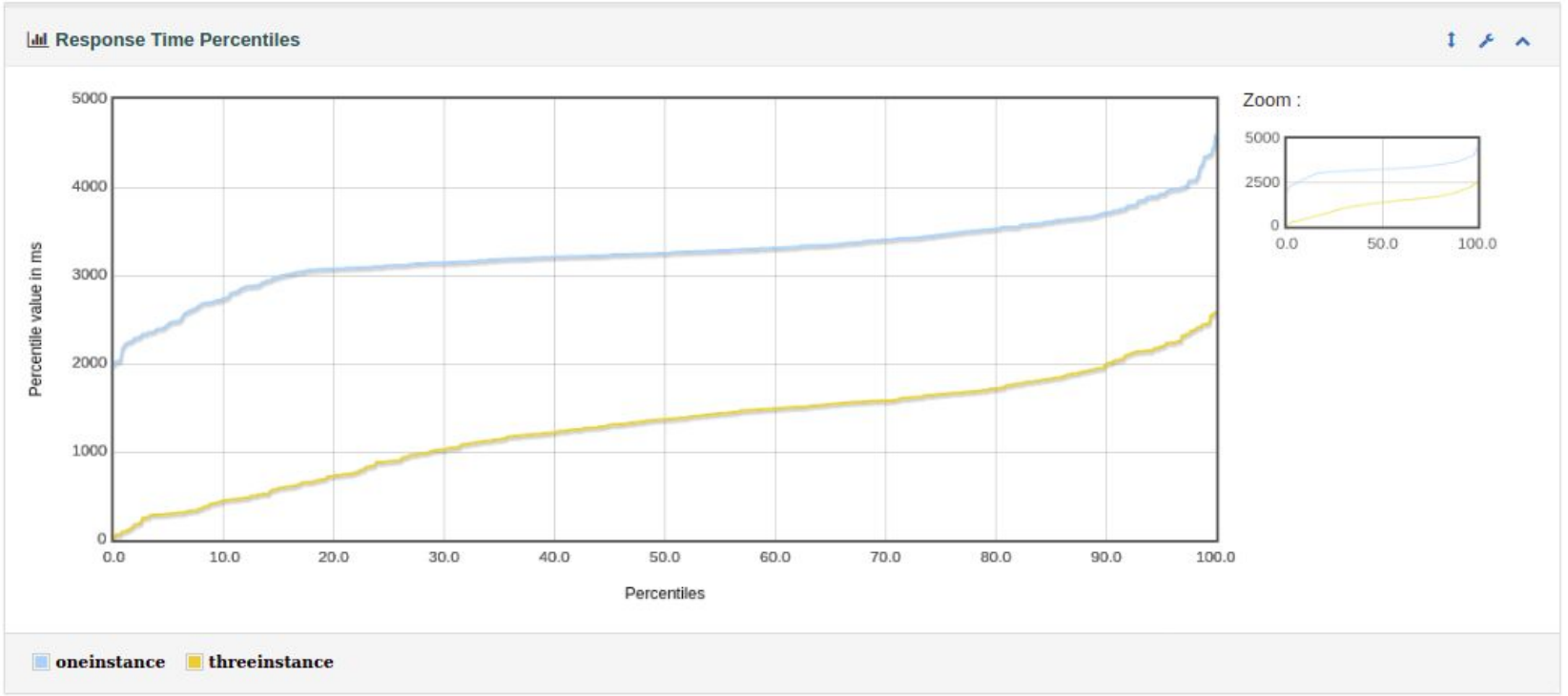

- Load balancing is achieved by running multiple instances of each microservice and hence the performance will be improved.

# RESPONSE TIME FOR DIFFERENT MICROSERVICE INSTANCES

| Microservice # | Microservice Name | Response Time(ms) (One Instance) | Response Time(ms) (Three Instances) |
|---|---|---|---|
| **1** | Part Service | 3260.84 | 1285.21 |
| **2** | Product Service | 7250.73 | 2659.34 |
| **3** | Compare Service | 5835.07 | 2880.34 |
| **4** | Incentives Service | 3489.36 | 1696.75 |
| **5** | Pricing Service | 5045.18 | 2999.06 |
| **6** | Dealer Service | 3208.39 | 1805.90 |
| **7** | Inventory Service | 3113.12 | 1670.80 |
| **8** | Lead Service | 3273.28 | 1780.96 |

- From the above table, we observe that performance of microservices can be improved by running multiple instances depending on the service consumption.

# RESPONSE TIME FOR DIFFERENT MICROSERVICE INSTANCES



# CONCLUSION

- We observed that coupling for Microservices application is less than that of SOA.
- Microservices application performs better than than SOA application
- Performance in Microservices architecture can be increased by running multiple instances of respective microservice.

# REFERENCES

**[1].**Taibi, Davide, Valentina Lenarduzzi, and Claus Pahl. "Architectural patterns for microservices: a systematic mapping study." SCITEPRESS, 2018.

**[2].**Raj, Vinay, and S. Ravichandra. "Microservices: A perfect SOA based solution for Enterprise Applications compared to Web Services." 2018 3rd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT). IEEE, 2018.

**[3].**Salah, Tasneem, et al. "Performance comparison between container-based and VM-based services." 2017 20th Conference on Innovations in Clouds, Internet and Networks (ICIN). IEEE, 2017.

**[4].**Bhallamudi P, Tilley S, Sinha A. Migrating a Web-based application to a service-based system-an experience report. In2009 11th IEEE International Symposium on Web Systems Evolution 2009 Sep 25 (pp. 71-74). IEEE.

# THANK YOU