Dec 31 Spring Cloud-Need of MicroServices

Spring Cloud (working with MicroServices)
==========

Need of MicroServices
==========

Monolithic Apps Vs SOA Apps Vs MicrorSErvices Apps

In spring Boot the Micro service archicture Apps will be implemented with support of spring Cloud Module and multiple other facilities

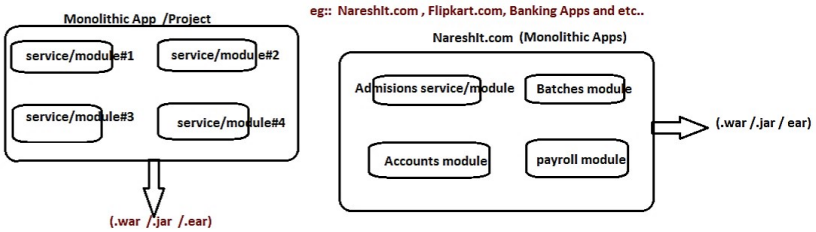
=> Generally we do not prefer using spring framework for MicroService implemenations .. we prefer spring boot a lot in the angel of spring boot cloud to implement MicroServices..

Monolithic Apps
==========

=>The Application the packs multiple services as multiple modules in a single unit (nothing but project) either as war file or jar file or ear file is called Monolithic Application/Project.

1 application = 1 Project contains multiple services as muitiple module inside the project/Application

=>So far the spring MVC Apps, spring data jpa Apps , spring core Apps and etc.. we developed are called Monolithic Apps
=> Even spring MVC with sprign data JPA /spring ORM/spirng JDBC that we have developed so far (except Spring Rest Apps) are called Monolithic Apps..



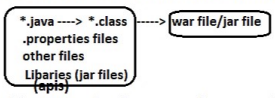
.war ==>web application
.jar ===> standalone App (Non-web applicaiton) / standalone web application (Using Embedded Server)

ear file = jar file + war file +..... (or)
ear file => jar file + jar file +jar file .... (or)
ear file => war file +war file +war file

ear file :: enterprise App archieve (now ear files not popular becoz web services comps also coming as war files .. When EJB was there ear files bit popluar to represent web applicaiton(war) + ejb comp (jar) togather as ear file

Build Process /Building the Application
==========

=>The process keeping the app ready for execution in certain env.. is called build process (or operations)



=> In buid process , developmentn of source code , compilaation of source code , development helper resources like properties files and other files , adding api libaries and etc.. will be there .. At last the war file or jar file will be created reprsenting the whole project.

What is the difference App /Service or API?

=>API --> application Programming Interface .. It is base for programmer to devleop certain language or technology or framework Apps. In Java api comes in the form of pkgs having classes,interfaces, enums and annotations.. These apis will be released /available in the form jar files (libaries/dependencies)

3 types of APIs :: a) pre-defifned apis (given by technology/language/framework vendor)
b) user-defined apis (given by developer)
c) third party apis (given by third party vendor)

=>Application/Service is the outcome of build process either in the form of jar file or war file having certain to task to perform.

note:: In the development App /Services in certain language/technology /framework we take the support APIs.

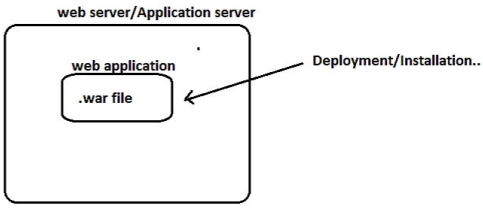
note:: The existing APIS/libraries can be used to create new APIs/Libaries or projects/Apps/sevices

eg: we can use hibernate api directly to develop hibernate persinstece logic /hibernate App
the spring creators have used the same hibernate api to develop spring ORM apis and spring data jpa apis

=>Jar file purpose will change context to context..
jar repsents apis
jar represents jdbc driver
jar represents standalone web application
jar represents ejb comp
jar represents web application (war file)
jar represents standalone App/project
and etc...

Deployment /Installation
==========

=>The process of keeping web application (.war file) in the server (either that is running or later started) is called deployment..



note:: In the devleopment /Testing env.. deployment takes place in Local servers or s/w companies cloud account (aws/ gcp/azure and etc..)
note: In the UAT and Production the deployment takes place in the Client Org Servers or Client org's Cloud Account

How build Process takes place in Realtime companies?

Ans) using Maven/ gradle Tool In combination with Jenkins CI/CD configration

CI :: Continous intergration
CD :: Continous Deployment

How do we pack app/service/project in to single unit having entire env.. for execution?

=>Only coding packing -----> war /jar file
=> Envirormment packing ---> docker image (code(war/jar) + server + DB + OS + ...)

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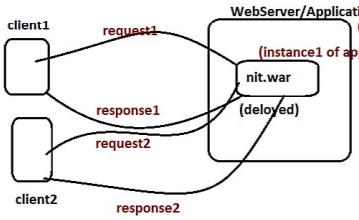
Service Instance / App Instance /instance

=>A runnig Application inside the server giving services to Clients (either for endusers or for other Apps) is callled Service Instance /instance /App instance..

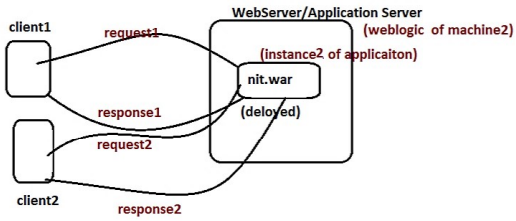
=> Each copy of app(jar or war) that is deployed in server successfully to render services for clients is called is called service Instance..

App/Project ---> is like class
each deployed App/Project giving services to clients is like instance
note:: One class can have multiple instances.. simpliarly one app/project can deployed in multiple servers i.e can have multiple instances/Service instances

nareshIT web application (App /Project) => (complted devleopment/testing)
(nit.war)



we can deploy the
the multiple instances /sevice instances of
one App/Project either in same server or
in different servers of same machine or different meachiens



In Every server we can specify max no.f requests that each service can allow , In most of the server this max request count is 200 by default

In spring boot MVC or spring Rest Apps we can change /control this max request count using the following properties of application.properties

In application.properties
---

server.tomcat.threads.max= 150 (default is 200)
server.iettv.threads.max= 300 (default is 200)

Load Count /Current Load

=> The no.of requests that are currently under proccessing by service instance is called Load Count /Current Load.
=> if the App1 instance/service instance is currently processing 10 requests then the Load count /Current Load is 10.

Load Factor

=> it is current Load/Max Load

=> Load factor = courrent Load/ max Load

=> if App instance with respect server max load is 150 and that app instance is processing only 100 request currently then 100/150 is the Load Factor (0.666)

Load Factory is always >=0 to <=1

maxLoad = max requests that server can take for each instance of the Application at a time
we can specify this using server settings or using application.properties while working with embedded servers of spring boot.

Scaling

=> Increasing the service capacity of App/SErvice /Project is called Scaling..

=> if the App is having facility to increase its service capacity as needed then it called scalable App.. (scalability feture)

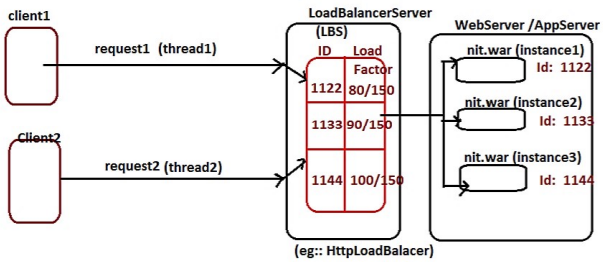
Examples :: eg1:: increasing shop capacity from 1000 square feet to 10000 square feet (vertical scaling)
eg2:: keeping same shop of 1000square feet in 10 places. (Horizontal scaling)
eg3:: increasing no.of ATM machies in different locations (Horizontal scaling)

Two types of Scaling

a) Horizontal Scaling (good)
b) Vertical Scaling

a) Horizontal Scaling

In Horizontal scaling we take the multiple copies same App i.e multiple service Instances to given services to Clients.. and we control these multiple instances with the support of Load Balancer Service (LBS)



These instances
can be there either
in same server different domains
or different copies of same server or different servers
residing in the same machine or different machines,

=> The given request goes to that instance/service instance of the App whose LoadFactor is less (whose value is nearer 0) .. In our example the both req1,req2 will go to instance beoz it is having less load factor (80/150). if all the instances are having same load factor then the LBS will pick up the instance randomly..

Examples for different LoadBalancer

- HAProxy – A TCP load balancer.
- NGINX – A http load balancer with SSL termination support. ...
- mod_athena – Apache based http load balancer.
- Varnish – A reverse proxy based load balancer.
- Balance – Open source TCP load balancer.
- LVS – Linux virtual server offering layer 4 load balancing.

and etc..

Keeping gmail App in different zones of world map falls under horizontal scaling.

Either DevOPs team or Infrastucture team like Linux admin and etc.. will take care of this kind Load Balancer..

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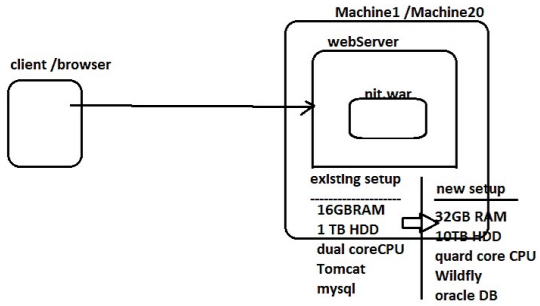
b) Vertical Scaling

=> Here we add more software or hardware infrastructure for the existing App env..
to make it ready for taking more requests from more clients.



In Cloud env.. like AWS
we get max of 720 GB RAM
and unlimited HDD suport
can be taken..

Pros and cons Monolithic architecture based Applicaiton Development
==========

pros (advantages)
==========

=> Provides simple and easy env.. to develop Projects/Apps as the Layered Apps having layers like presnetation layer , controller layer , service Layer , Persistence Layer(DAO), Integration layer and etc..

note: Most of the current maintainance projects are Monolithic projects
=> Easy to deploy (all togather single jar/war file) , easy to manage (single war/jar file) , easy to scale (increasting or decresing instances)
=> Performing unit Testing is very easy becoz all layers and all services are avaiable togaher
=> Less possiblity of getting network related issues becoz all services /layers mostly there togather.
=> Performing logging and dubegging operations is very easy.. (Even Adutiing activities are easy)

cons (DisAvatages)
====

=> For small or tiny changes in one or two services /modules /layers we need redeploy the application by alterting the endusers when App in the production. (App will not for these many hours) work

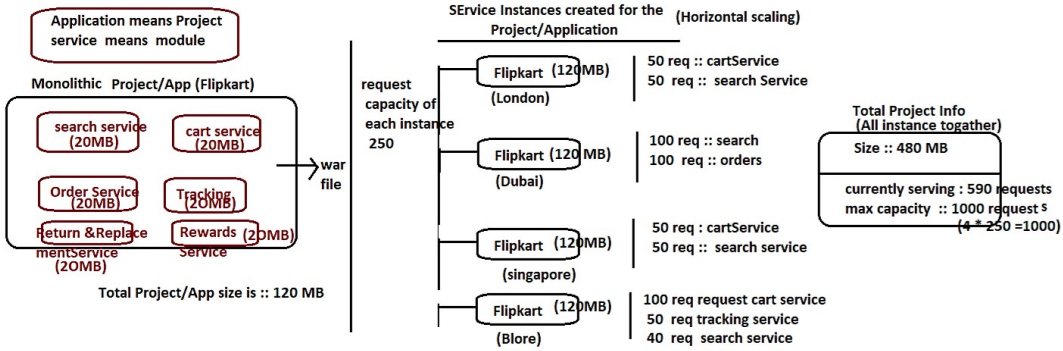
=> one bug or issue in one module/service of Project/App may effect other services /modules ..this indicates these Apps are not reliable. (Sometimes Apps will shutdown providing no services to clients)

=> Adding new technologies /concepts/ frameworks in the existing as part of enhacement is very complex sometime we will be forced to redesign the project..

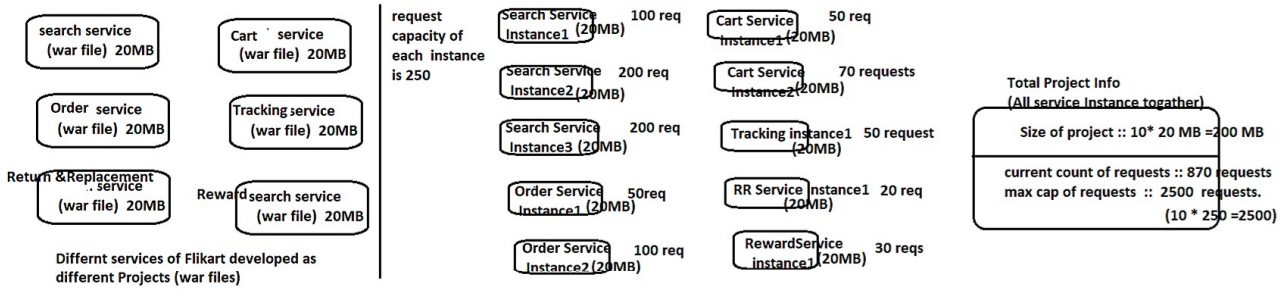
=> if no.of modules/services are incresed in the Project then their maintainace towards bug fixing and redeployment also takes lots of time while working with websErver and application server .. (This may cause increasing App/Project downtime)

=> we can not sell certain services /modules of one Project to clients as they need...

=> Since we can create service instances only for entire App .. not for certain services/modules of the Project lots of memory and CPU time wastage will be there.
and etc..



Let us assume we are able to create seperate project/App for every service/Module (Horizontal scaling by taking modules/sericces as the Projects/Apps)
==========



=>This kind of Application development in Monolithic architecture is possible but very complex to implement and manage .. To overcome this problem we have got MicroServices Archicture..

SOAP based web service fall under SOA
Restfull webservices fall under Producer- Consumer mechanism

note:: MicrorServices Archicture is enhacment Producer-consumer mechanism where we develop each microservice as restfull App

What is the link between webServices and MicroServices?
Microservices are extension of webServices (Restfull webservices) In fact each micro service will be developed as one Restfull webservice by adding other facilities.

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Monothilic vs SOA vs MicroServices archicture

SOA (Service Oriented Architecture)

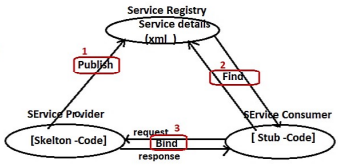
=> This architecture given to get communication between two applications that are developed in two different technologies and running from two different machines using Register and Discovery Concepts..

=>SOAP based webServices (like Jax-ws, axis ,apche cfx and etc..), CGI-Links are given as the implmenentation models of SOA Design..

=>SOA is design that provides certain archicture with principles to get communication between two incompitable Apps..

3 comps SOA

a) Service Provider
b) Service Consumer
c) Service Registry



1.Service Provide develops the prodiver App and exposes it details to serviceRegistry in the form of xml docs (Publish Operation)

2. TheService consumer contacts the ServiceRegistry and get the details about provider or service (Find Operation)

3. The service consumer prepare stub code to consumer services of the Provider using request-response model (Bind Operation)

Advatntages of SOA

1) Interoperability :: we can develop the Provier and consumer Apps either in same technology or in different technologies

2) Easy Maintainace :: Any change in provider App , we just need to update to Service registry and need not inform to all consumers..becoz Service cosumer can collect the changes from SErvice Registry

3) Quality Code is guaranteed :: Since we can develop provider App in our choice technology So we can given quality provider App..

4) Scalable :: we can add more parellel servers or instanstaces for provider App as service consumers and their no.of requests are incresing

4) realiable :: Since the SOA machanism is involving the Service Registry .. we can maintain our Distributed App in reliable and stable state..

DisAdvantages ::

HighCost :: It needs lots of man power and technology /infrastrucure support for developing SOA applications

Xml utilization :: Supports only XML based Data exchange which is fading out day to day

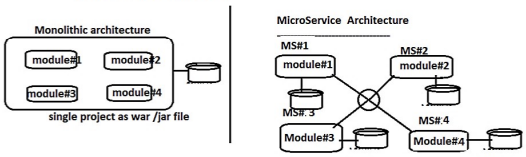
HighBandwidth of internet required :: Since service registry ,Service Providers will be placed in different locations we definelty need good bandwith of internet connections.

MicroServices Architecture (Extesion Restufull web service model)

=>In this architecture every service /module will be developed as seperate project/App having connection with other service/module..

=> It is Decoupled Archicture of a single Project becoz multiple services/modules will be devleoped as multiple projects and they will be registered/Integrated in a common place.

=> Micro SErvice is small service or small application
micro = small
service = project/ Application..



Every Micro service will be developed as Restfull App /RestController and will be place in common registry/server to make it avaiable for other micro services or Client Apps.

Advatnatages of MicroSErvice Architecture

=> Need not stop other services /modules (MicroServices) if problem comes in certain module/service [if Rewards or Feebback sevrice failed it does not effect other services like sales , orders, cart and etc..]

=> Need not stop all other the services .. while updating /patching certain service for betterment

=> We can use different Technologies to develop different services of the Project/application..

=> We can do horizontal scaling for each service as needed i.e if certain service like searching, cart and etc.. are having more demand then we can create more instances for them by enabling Load Balancing

=> Updgrading/Migrating to new tehchnologies in each service is no complex .. Quite easy compare to monolithin architecture

=> Service Down time (while performing reloading or restart or redployment activities) less becoz we need to perform these actitvies on one service at time.

=> Allows to place common things of multiple Services (MicorServices) in a common place like GIT hub env.. instead of placing in every service/ module

note:: Developing MicroServices using spring boot is very easy becoz most of the common things like DB setup , Schema initializations and etc.. can be cfg to occur through auto Configuration of spring boot

Limitations of MicroServices

=>Maintainance of the Project is very complex becoz it generates multiple log files , contains multiple communication chains and debugging the code across multiple services is too difficult..

=> Needs high end intrastruture to maintain multiple micro services , if going for Cloud we need to purchase /rent muliple things to deploy and manage these projects.

=> Knowlege on More Tools , technlogies and processes is required to work with MicroServices Projects

=> Migrating Monothic Project into MicroServices project is very complex

=> Testing is bit difficult if one microservice is having dependency with other micro service.

note:: we generally uses Cloud env.. to deploy and execute the modren monolithic , SOA and Micro services projects.. Working with with Cloud is nothinb but taking things on Rental basis and using them for our requirements..
eg:: AWS , Azure , Goolge clould, PCF (Pivotal Cloud Foundary) , RackSpace and etc..

Clould env.. (AWS/Azure ...)

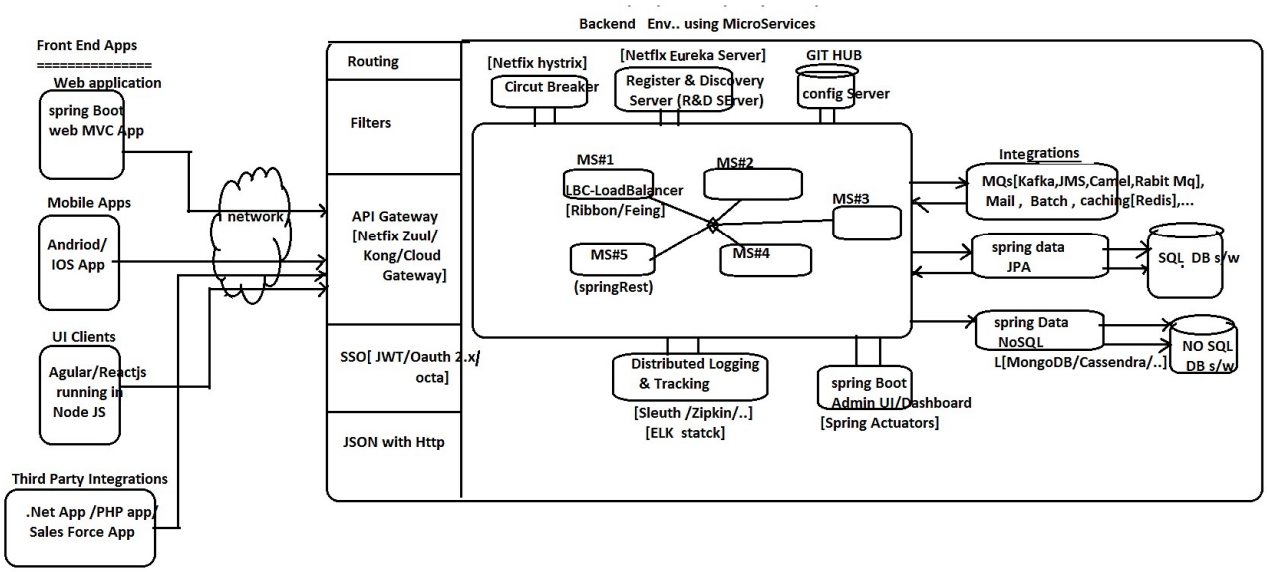
IAAS	PAAS	SAAS
RAM	Linux	=>web server/App servers
HDD	windows	=>DB s/w
network	Ubentu	=>Mail servers
CPU	MAC	=JDBC drivers
RACKs	Device Drivers	=>MQ Services
...		=>Jdk s/w
		=> Jenkins
		=> Docker
		....

Cloud services
a) PAAS :: Platform As A service
b) IAAS :: Infrastrutur As A service
c) SAAS : Software As A service

=> MicroServices architeture is Design and whose Apps/Projects can be implemented/ developed in spring env.. with the support of spring boot + spring clould + tools

Jan 05 MicroServices overview

Overview of MicroService Archicteture



Micro service Architecture is Desinging or specification which provides set of rules and guidelines to develop Project as set of loosely coupled /De coupled Services .. and this can implemented using spring boot +spring cloud + Netflix and lots of other tools.

=> Every module in the project will be develop as seperate microservices in the form of spring RestController with the support of spring boot env..

=> Once the Microservic architecture project is ready .. It will be deployed in cloud env..like AWS/AZure/Google Cloud and etc.. with DevOPs tools Jenkins with CI/CD + Docker + Ansible + Kubernate +....

=>After developing each Micro SErvice as seperate Spring Rest App/Project it must be published in a common place called R & D SErver (Register And Discovery Server) like Netflix Eureka server

=> One MicroSErvice can find another MicroService in R & D SErver and can be used for Communication Through the same old R & D Server..

=> One MicroService can find and communicate with another microservice only when it is published in R & D server ..

=> The common properties with same values of Multiple Micro services can be placed outside the Micro services in place called Config server like GIT Hub

=> if any exception is raised in the execution of one microService then it has to be informed to Admin UI /Dashboard with the support of Circuit Breker like Netflix hystrix.

=> if any MicroService is having more demand then we allows to create multiple instances dynamically.. In that situation to pick up right istance with less Load factor from other MicroServices we take the support of Load Balancer Clients (LBC) like Ribbon ,Feign ,Http LoadBalancer and etc..

=> since we are devleoping every MicrService as Spring Rest App in spring boot env.. So we can make these Micro services Apps integrating with lots of other facilities like MQs (Message Queries), Mail, Caching, Batch PRocessing and etc..

=> MicroServices can interact with SQL Db s/ws using spring data jpa

=> MicroServices can interact with No SQL Db s/ws using spring data Nosql modules like spring data mongoDB ,spring data cassendra and etc..

=> To Monitor and Manage all the MircorSErvices of the Project .. we try to spring boot Admin UI/Dashboard that is created using support of spring boot Actuators which are also useful providign non-funcational features like Health metrics on the projects..

=> Since Project contains multiple microSErvices interacting with each other..So we need perform logging and tracing activity across the multiple micro services as needed with the support Distributed Logging and tracking tools like slueth and zipkin

=> The MicroServices of the Project can have different types of Clients (Front end Apps) mobile Apps , web mvc Apps, Third party Apps , UI Technologies App and etc..

=> To use all these microServices and tools from different types of Clients /Front end Apps we need one common entry and exit point concept nothing but API Gateway like netflix zuul/Kong and etc.. providing facilities to apply Filters , Routers , SEcurity like SSO (Single Sign On) and etc..

Jan 06 Eureka Server

Spring Cloud - Netflix Eureka Server

=>Every MicroService must be registered or published with R & D (Register and Disocovery) server in order to make it discoverable/communicatable from other MicroServices

=> As of now netflix eureka server (best), apache zookeeper are two popular R & D Servers.

=> Every R & D server is spring boot Project having R &D Server dependencies (Do not except seperate installation like Tomcat, wildfly and etc..)

=> The Process of keeping /publishing MicroService details in R &D Server is called registration activity

=> The process of discovering/fetching MicroService details from R & D Server to esstablish communication/interaction from another MicroService is called Discovery Operation.

=> When we publish different instances of different micro services to R & D server like Eureka server .. then the details will look like this...

Service Id	InstanceId	HostName/IPAddrs	LoadFactor [CurrentLoad/ MaxLoad]
Search-Service	SS:566-a367	192.6.8.7 7878	0/200
Search-Service	SS:536-a461	192.6.8.7 7171 (IPaddrs / port number)	0/200
Order-Service	OS: 455-a356	192.6.8.7 8989	0/200
Order-Service	OS: 415-a256	192.6.8.7 8182	0/200

=>Eureka Server is no documents server .. i.e it does not contain any xml files or Json files inside the server .

=> Service Id is always Project name (Service Id is called as Service Name)

=> Instance id is the unique Id .. For every Instance one unique instance Id will be generated..

=>Providing isntance Id when single instance is there optional .. In that situation it takes ServiceId as the Instance Id

=> The HostName and port details will be auto detected by Eureka server durigng the process Register/publishment

=> LoadFactor = current Load /Max Load.

Procedure to create Spring Boot project acting as Eureka server

==========

step1) create Spring Boot Project adding Eureka Server as depedencies

step2) add @EnableEurekaServer on the top of main class

```
@SpringBootApplication
@EnableEurekaServer
public class SpringBootMsProj01EurekaServerApplication {

	public static void main(String[] args) {
		SpringApplication.run(SpringBootMsProj01EurekaServerApplication.class, args);
	}

}
```

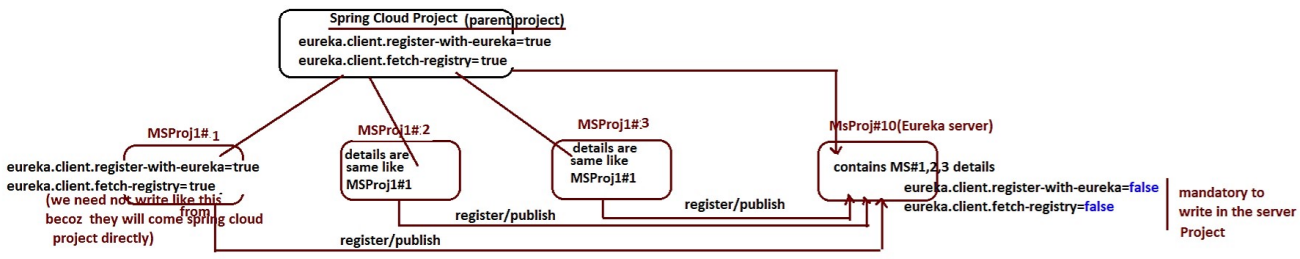
step3) Add the following entries in application.properties

To disable the process of making this project as MicroService and to present this project as R & D Server

appplication.properties

```
server.port=8900
eureka.client.register-with-eureka=false
eureka.client.fetch-registry=false
```

=>spring boot project we get Eureka server as the Embedded Server..



=> Every Ms Project should kept ready to register with Eureka Server .. Since we can not register Eureke server Project itself with Eureka server , So we need to make the default value "true" Inherited from the spring cloud project for "eureka.client.register-with-eureka" property as "false" in Eureka server Project.

```
eureka.client.register-with-eureka=false
```

=>Every MS project should be kept ready for discovery/fetching for communincation while registering with Eureka server .. Since Eureka Server Project can not kept ready for fetching/discovery so we need make the default "true" inhreited from the spring cloud project for "eureka.client.fetch-registry" as "false" in Eureka server Project

```
eureka.client.fetch-registry=false
```

The default port number for eureka server is :: 8761

step4) Run the application...

Right click on Project -->run as --> java app/spring boot app

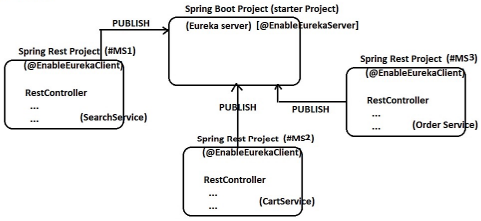
step5) Test the SErver App

http://localhost:8900/

Jan 07 Publishing MS to Eureka Server

Publishing MicroService to Eureka server (R & D Server)

=> Every Ms must be published/registered with Eureka Server (R&D Server) by becoming Eureka client
=> we need to develop MicroService as Spring RestController adding the the support of @EnableEurekaClient



Procedure for MS Development and Publishing

step1) Make sure One Spring boot Project alreay developed and running as Eureka Server (Previous class) *(make sure that it is running the default port : 8761)*

step2) Create Spring Boot Starter Project adding spring web, EurekaClient Dependencies (MicroService Development)
Discovery

step3) Place @EnableEurekaClient Annotation on top of main class.

```
@SpringBootApplication
@EnableEurekaClient
public class SpringBootMsProj01SearchServiceApplication {

    public static void main(String[] args) {
        SpringApplication.run(SpringBootMsProj01SearchServiceApplication.class, args);
    }

}
```

step4) add the following entries in application.properties file
in applicaiton.properties

```
# MS service port number
server.port=7171

# Service Id
spring.application.name=Search-Service

# Specify the Eureka server URL to publish the MS
eureka.client.service-url.default-zone=http://localhost:8761/eureka
```

fixed path for publishing

step5) Develop RestController representing the MicroService

```
package com.nt.controller;

import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;

@RestController
@RequestMapping("/search")
public class SearchServiceController {

    @GetMapping("/display")
    public String displayMessage() {
        return "Welcome to Flipkart Search Service";
    }
}
```

step6) Run the MicroService Project as spring boot App
(This process automatically publishes MS to Eureka server)

step7) Refresh the home page of eureka server (http://localhost:8761) and observe the instance section

Instances currently registered with Eureka

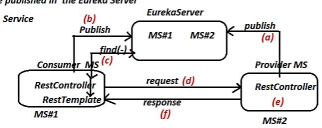
Application	AMIs	Availability Zones	Status
SEARCH-SERVICE	n/a (1)	(1)	UP (1) - DESKTOP-IUDAAVL:Search-Service:7171

step8) Collect url from status section and modify it to generate the request to MS

http://desktop-iudaavl:7171/search/display
(or)
http://localhost:7171/search/display

Inter communication between MicroServices

=> To see communication b/w two micro services .. both micro services must be published in the Eureka Server
=> The MS that provides services is called Provider/Server /Producer /Parent Service
=> The MS that cosumes services is called Cosumer/Client /Child Service



CartService <----------> PaymentService
(consumer/client) (Procudure/Server)

Employee <----------> Department
(consumer/Client) (Procudure/Server)

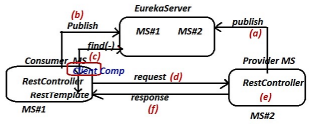
CartService <----------> Billing Service
(consumer/Client) (Procudure/Server)

Generally the the Cosumer and Producer Apps will be represented as show below
(parent and child)

Payment service --------◇ cart service
(parent) (child)

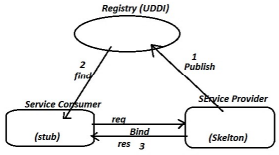
Doctor ◇---------- Patient
(parent) (child)

MicroService style intra communication



Here both Consumer and Provider services will be published to Eureka server before starting interaction

SOA style Intra communication

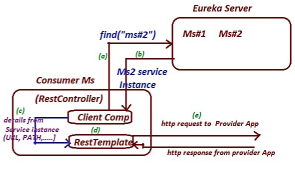


Here only provider Service will be published.

=>In the intra communication of MicroService through Eureka Server the Consumer /Client/ Child MS should find and get the details of Provider/Producer/Server MS by submitting its service Id .. For this the Cosumer MS must use one special comp "Client Comp/ Client Type comp".

=>The work of "Client comp" in Consumer Ms is
a) getting Producer MS service Instance from Eureka SErver by submitting its Service Id
b) Gathers Producer MS details like URL/URI ,method type, PATH and etc.. from Service Instance
c) Passing the above details to RestTemplate of Consumer MS to make RestTemplate to send http request to Producer Ms

As of now In Eureka server env.. 3 types of "Client Comps/Client type comps" are possible
a) Discovery Client Comp (Very Basic Client -- Legacy)
b) LoadBalance Client comp (good)
c) Feign Client Comp (Abstract Client -- Good)



jan 09 Ms-Intra Communication

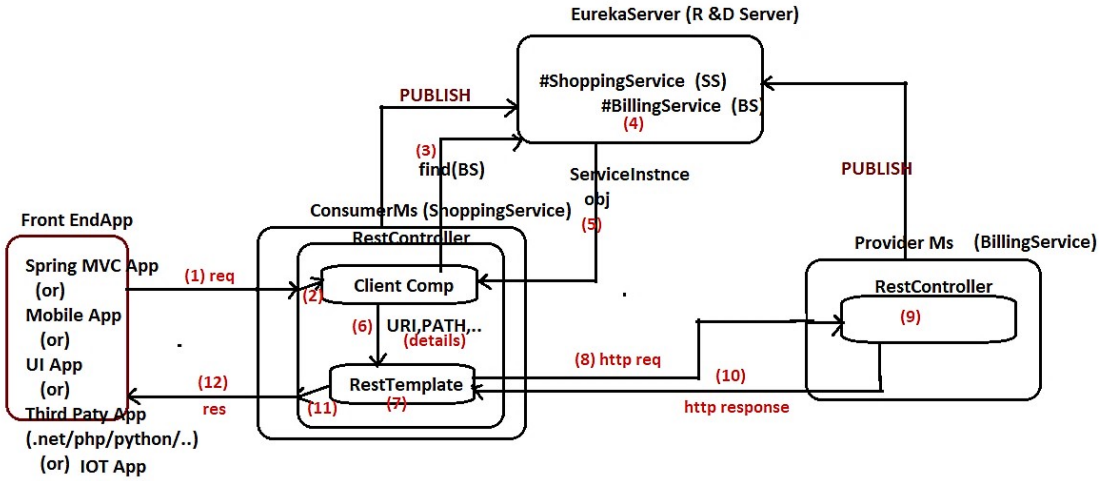
MicroServices Intra Communication
==========

=> We can perform intra communication between micro services by publishing them in the Eureka Server ...

=> The Cusumer Ms must use one or another "Client Comp" or "Client Type comp" to get multiple details about Provider MS by passing service Id .. These multiple details are like URI, PATH, method type,path variables and etc.. will be passed RestTemplate obj to make Http Call to connect with Provider Ms

=> The Consumer MS can work with 3 types of "Client Comps" or "Client Type comps"

> DiscoveryClient (Legacy)
> LoadBalancerClient (for Load balacing) (good)
> FeignClient (Abstract Client) (good)



Example App development (as POC) ==========

(Using DiscoveryClient as the Client Comp)

step1) Develop Project as Eureka Server

=>dependencies :: Eureka service
=> add @EnableEurekaServer on the top of main class
=> application.properties

```
server.port=8761
eureka.client.register-with-eureka=false
eureka.client.fetch-registry=false
```

step2) Develop Project as Producer MicroService

=>dependencies :: web , EurekaDiscoveryClient ,devtools

=> add @EnableEurekaclient on the top of main class

=> application.properties

```
#Ms Properties
#Port number
server.port=9900
#Service id
spring.application.name=Billing-Service
#Eureka server publishing info
eureka.client.service-url.default-zone=http://localhost:8761/eureka
```

=> Develop RestController having producer b.methods

```
//RestController (provider)
package com.nt.controller;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;
@RestController
@RequestMapping("/billing")
public class BillingServiceController {

    @GetMapping("/info")
    public String getBillingInfo() {
        return "we accept Card Payment , UPI Payment, NetBaking Payment, COD";
    }
}
```

step3) Develop the Cosumer MicroService (Shopping Service)

=>dependencies :: web , EurekaDiscoveryClient ,devtools
=> add @EnableEurekaclient on the top of main class

=>application.properties

```
#Ms Properties
#Port number
server.port=6600
#Service id
spring.application.name=Shopping-Service
#Eureka server publishing info
eureka.client.service-url.default-zone=http://localhost:8761/eureka
```

-> Develop spring bean (@Componet) as helper class having logic to use DiscoveryClient as the ClientComp to find and get Producer/provider Ms Instance and Details

```
http://localhost:9900   (URI)
http://localhost:9900/billing/info (URL)

        URL=URI +PATH
```

jan 09.1 Ms-Intra Communication

```
//RestConsumer
==============
package com.nt.client;
import java.util.List;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.cloud.client.ServiceInstance;
import org.springframework.cloud.client.discovery.DiscoveryClient;
import org.springframework.stereotype.Component;
import org.springframework.web.client.RestTemplate;
@Component
public class BillingServiceRestConsumer {
      @Autowired
      private  DiscoveryClient  client;  //comes through  AutoConfiguration
                                 //client Comp

      public  String  getBillingInfo() {
            //find and get SErviceInstances  of Producer by using Service Id
            List<ServiceInstance>  listSI=client.getInstances("Billing-Service");
            // use  first ServiceInstance from the List of Instances
            ServiceInstance  SI=listSI.get(0);
            //get Producer MS URI  and make it  as URL
            String url=SI.getUri()+"/billing/info";
            // create RestTemplate object
            RestTemplate  template=new RestTemplate();
            // invoke producer MS service method or operation by generating Http call
            String  resp=template.getForObject(url,String.class);
             return resp;
      }//method
}//class
```

note:: All producer and consumer Ms must be annotated with @EnableEurekaClient

=> Develop RestController in consumer Application by taking the support of above helper class..

```
  //Rest Controller
  package com.nt.controller;
  import java.util.function.Consumer;
  import org.springframework.beans.factory.annotation.Autowired;
  import org.springframework.web.bind.annotation.GetMapping;
  import org.springframework.web.bind.annotation.RequestMapping;
  import org.springframework.web.bind.annotation.RestController;
  import com.nt.client.BillingServiceRestConsumer;
  @RestController
  @RequestMapping("/shopping")
  public class ShoppingController {
        @Autowired
        private BillingServiceRestConsumer consumer;

        @GetMapping("/info")
        public  String   displayShoppingDetails() {
              return  "Pongal Shopping for Family ...."+consumer.getBillingInfo();

        }                    One MS  RestController is  using another MS RestController
  }
```

step4) Execute the Projects/Apps in the following order

8761 -server
9900 -producer
6600 -consumer

=>run the Eureka Server
=>Run the Produder App (BillingService)
=> Run the Cosumer App (ShoppingService)
=> Go to Eureka Server Console to modify Consumer Service Url for testing..

original url ::
http://desktop-iudaavl:6600/actuator/info
modified url :: http://desktop-iudaavl:6600/shopping/info

Pongal Shopping for Family ....we accept Card Payment , UPI Payment, NetBaking Payment, COD

Limitations of DiscoveryClient type ClientComp
==========

(a) We get list of target MS instances and we need to instance manually .. But actually want
one instance of target MS(Producer Ms) which having less Load Factor (Load balacing is not possible)

(b) This Baisc Client Comp or Client Type which very much Legacy .. i.e it is not indurstry standard..

(c) Collecting one instance from the list of instance is pure responsibity of Cosumer App that to manual process.. So other instancces of target/produce Ms may sit idle..

note:: To overcome these problems take the support of LoadBalancerClient type Client Comp.

LoadBalancerClient
==========

=> It is another Client type Comp or Client Comp .. which choose the less load factor instance though they are multiple instances for Target /Procuder Ms i.e we never get List of instances though they are muliple instances for MS.. we always get one instance of MS which is having Less LoadFactor

=>LoadBalnaceClient is an interface and implementation is given by Spring Clould NetFlix peopled in the form of RibbonLoadBalanceClient class which can be injected to Cosumer App through AutoConfiguration..

=> The method choose(-) with instance Id called on the LoadBalanceClient obj will bring the Less LoadFactor Instance of target /producer Ms.

note:: To create multiple instances for any MS run that Ms App for multiple times with different Port numbers becoz Two Servers or Two Ms of same computer can not take same port number .. but possible across the multiple machines.

jan 09.2Ms-Intra Communication.png

Example App using LoadBalanceClient Type Client Comp (MS intra communication using LoadBalanceClient)

step1) Develop Eureka Server App same as previous App

step2) Develop Producer/Provider/Target MS (This time provide random number as the instance Id)

=>Since we are planning take multiple instances of producer App by running the Producer App for multiple times it is better to give seperate name for every instance generally it is serviceId:<randomvalue> using

```
eureka.instance.instance-id=${spring.application.name}:${random.value}
```

App name as the ServiceId — System property giving one psuedo random number for every execution

(do not add dev tools)

=> create project having sprigng web , CurekaDisoveryClient, dependencies

=> add @EnableEurekaClient on the top main class

=> add the following entries in application.properties

application.properties

```
#Ms Properties
#Port number
server.port=9900
#Service id
spring.application.name=Billing-Service
#Eureka server publishing info
eureka.client.service-url.default-zone=http://localhost:8761/eureka
# provid applicaiton + radom vlaue as Instance Id
eureka.instance.instance-id=${spring.application.name}:${random.value}
```

LoadBalancerClient

=> It is another Client type Comp or Client Comp .. which choose the less load factor instance though they are multiple instances for Target /Procuder Ms i.e we never get List of instances though they are muliple instances for MS.. we always get one instance of MS which is having Less LoadFactor

=>LoadBalnaceClient is an interface and implementation is given by Spring Clould NetFlix peopled in the form of RibbonLoadBalanceClient class which can be injected to Cosumer App through AutoConfiguration..

=> The method choose(-) with instance Id called on the LoadBalanceClient obj will bring the Less LoadFactor Instance of target /producer Ms.

note:: To create multiple instances for any MS run that Ms App for multiple times with different Port numbers becoz Two Servers or Two Ms of same computer can not take same port number .. but possible across the multiple machines.

Example App using LoadBalanceClient Type Client Comp (MS intra communication using LoadBalanceClient)

step1) Develop Eureka Server App same as previous App

step2) Develop Producer/Provider/Target MS

(This time provide random number as the instance Id)

=>Since we are planning take multiple instances of producer App by running the Producer App for multiple times it is better to give seperate name for every instance generally it is serviceId:<randomvalue> using

```
eureka.instance.instance-id=${spring.application.name}:${random.value}
```

App name as the ServiceId — System property giving one psuedo random number for every execution

(do not add dev tools)

=> create project having sprigng web , CurekaDisoveryClient, dependencies

=> add @EnableEurekaClient on the top main class

=> add the following entries in application.properties

application.properties

```
#Ms Properties
#Port number
server.port=9900
#Service id
spring.application.name=Billing-Service
#Eureka server publishing info
eureka.client.service-url.default-zone=http://localhost:8761/eureka
# provid applicaiton + radom vlaue as Instance Id
eureka.instance.instance-id=${spring.application.name}:${random.value}
```

=> Develop Restcontroller actiging Producer MS

```
package com.nt.controller;

import org.springframework.beans.factory.annotation.Value;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;

@RestController
@RequestMapping("/billing")
public class BillingServiceController {
 @Value("${server.port}")
 private int port;
 @Value("${eureka.instance.instance-id}")
 private String instanceId;

@GetMapping("/info")
public String getBillingInfo() {
      return "we accept Card Payment , UPI Payment, NetBaking Payment, COD---> port::" +port+"----InstanceId::"+instanceId;
}
}
```

Injected to know which instance is picked by LoadBalanceClient to cosume the Producer services (purely optional)

jan 09.3 Ms-Intra Communication

step3) Devlop the Consumer App with support of LoadBalanceClient

(do not add dev tools)

=> create project having sprigng web , CurekaDisoveryClien dependencies (Ribbon comes automatically)
=> add @EnableEurekaClient on the top main class
=> add the following entries in application.properties

```
#Ms Properties
#Port number
server.port=6600
#Service id
spring.application.name=Shopping-Service
#Eureka server publishing info
eureka.client.service-url.default-zone=http://localhost:8761/eureka
```

=> develop helper having LoadBalanceClient comp Injection

```
package com.nt.client;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.cloud.client.ServiceInstance;
import org.springframework.cloud.client.loadbalancer.LoadBalancerClient;
import org.springframework.stereotype.Component;
import org.springframework.web.client.RestTemplate;

@Component
public class BillingServiceRestConsumer {

    @Autowired
    private LoadBalancerClient client; //comes through AutoConfiguration

    public String getBillingInfo() {
        //get Less LoadFatory Service Insntance
        ServiceInstance SI=client.choose("Billing-Service");
        //get Producer MS URI and make it as URL
        String url=SI.getUri()+"/billing/info";
        // create RestTemplate object
        RestTemplate template=new RestTemplate();
        // invoke producer MS service method or operation by generating Http call
        String resp=template.getForObject(url,String.class);
        return resp;
    }//method
}//class
```

=>Develoe the RestController

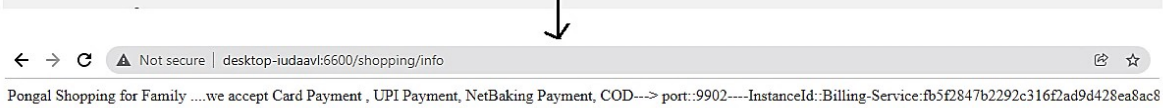
```
package com.nt.controller;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;

import com.nt.client.BillingServiceRestConsumer;

@RestController
@RequestMapping("/shopping")
public class ShoppingController {
    @Autowired
    private BillingServiceRestConsumer consumer;

    @GetMapping("/info")
    public String displayShoppingDetails() {
        return "Pongal Shopping for Family ...."+consumer.getBillingInfo();
    }
}
```

step4) run Apps in the following order

=>run Eureka server App
=> Run Producer Apps multiple times but change port number in application.properties each time (at least 2 times)
=> Run the Cosumer App

=>Go to Eureka server Consle modify the Consumer App url

Application	AMIs	Availability Zones	Status
BILLING-SERVICE	n/a (2)	(2)	UP (2) - Billing-Service:cc78dd2418223af081691cb6054a459f , Billing-Service:8fa7b22275cccff553b00ffe7d335591
SHOPPING-SERVICE	n/a (1)	(1)	UP (1) - DESKTOP-IUDAAVL:Shopping-Service:6600



Pongal Shopping for Family ....we accept Card Payment , UPI Payment, NetBaking Payment, COD---> port::9902----InstanceId::Billing-Service:fb5f2847b2292c316f2ad9d428ea8ac8

Jan 10 Ms-Intra Communication-Feign Clent

MicroServices Intra Communication

==========

Limitation with Discovery Client , LoadBalancerClient

=> They can find and get producer MS ServiceInstance and other details from Eureka Server .. But they can not give http calls to interact with target/Producer MS For that we need to use RestTemplate seperately

=> we need to coding manually to find and get Target MS Service Instance

To overcome this problems use Feign Client as Client Comp/Client Type comp

Feign Client /Open Feign

==========

=> It is called abstract client becoz we just provide interface with method declaration and adding annotation .. But entire logic will be generated in the InMemory dynamic proxy class (Proxy pattern)

=>It is Combination Client i.e it takes getting taget/producer Ms service Instance from Eureka server and also takes care of interacting target/Producer Ms by generating http calls that to with out wrting code.

=> It is internally LoadBalancer Client i.e it gets Target/Producer Ms service Instance from the List of seerviceInstances which having Less Load Factor.

=> This mode of Client Comp development improves the productivity of the App.

=> Here we do not develop helper RestConsumer for Consumer RestController rather we develop Interface having @FeignClient("ServiceId") and the generated InMeory DyamicProxy class object will be injected to ConsumerRestController.

=> While worokign with FeignClient we need to add 2 annotation special annotations along with regualar annotations in the Consumer App

a) @EnableFeignClients on the top main class along with @EnableEurekaClient

b) @FeingClient on the top of interface for which dynamic Inmemory proxy class will be generated.

must match with taget/producer MS service Id

```
@FeingClient("Billing-Service")
public interface IBillingServiceRestConsumer{
@GetMapping("/billing/info")          // target/producer MS method /operation path
public String getBillingInfo();
}
```

singnature should mattch with target Ms method

method name need not to match taret MS method name

Example App Using Feign Client

==========

step1) Develop Project as Eureka Server

=>dependencies :: Eureka service of

=> add @EnableEurekaServer on the top main class

=> application.properties

```
server.port=8761
eureka.client.register-with-eureka=false
eureka.client.fetch-registry=false
```

step2) Develop Project as Producer MicroService

=>dependencies :: web , EurekaDiscoveryClient ,devtools

=> add @EnableEurekaclient on the top of main class

=> application.properties

```
#Ms Properties
#Port number
server.port=9900
#Service id
spring.application.name=Billing-Service
#Eureka server publishing info
eureka.client.service-url.default-zone=http://localhost:8761/eureka
```

=> Develop RestController having producer methods

```
package com.nt.controller;

import org.springframework.beans.factory.annotation.Value;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;

@RestController
@RequestMapping("/billing")
public class BillingServiceController {
 @Value("${server.port}")
 private int port;
 @Value("${eureka.instance.instance-id}")
 private String instanceId;

 @GetMapping("/info")
 public String getBillingInfo() {
       return "we accept Card Payment , UPI Payment, NetBaking Payment, COD---> port::"+port+"----InstanceId::"+instanceId;


   }
 }
```

Jan 10.1 Ms-Intra Communication-Feign Clent

step3) Develop Cosumer MS Project adding spring web , EurekaDiscoveryClient ,open Feign

=> Add @EnableEurekaClient , @enableFeignClients annotations on top of main class

```
@SpringBootApplication
@EnableEurekaClient
@EnableFeignClients
public class SpringBootMsProj04ShoppingSErviceConsumerApplication {

public static void main(String[] args) {
        SpringApplication.run(SpringBootMsProj04ShoppingSErviceConsumerApplication.class, args);
}
}
```

=> add the following entries in application.properties

```
#Ms Properties
#Port number
server.port=6600
#Service id
spring.application.name=Shopping-Service
#Eureka server publishing info
eureka.client.service-url.default-zone=http://localhost:8761/eureka
```

=> Take an interface supporting FeignClient code as InMemory Dynamic Proxy class

```
package com.nt.client;

import org.springframework.cloud.openfeign.FeignClient;
import org.springframework.web.bind.annotation.GetMapping;

@FeignClient("Billing-Service")
public interface IBillingServiceRestConsumer {

    @GetMapping("/billing/info")
    public String fetchBillDetails();

}
```

=>Develop the Cosumer RestrController Injecting FeignCleint related Proxy object to consume the target /Producer Ms services.

```
//RestController
package com.nt.controller;

import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;

import com.nt.client.IBillingServiceRestConsumer;

@RestController
@RequestMapping("/shopping")
public class ShoppingController {

@Autowired
private IBillingServiceRestConsumer consumer;

@GetMapping("/info")
public String displayShoppingDetails() {
System.out.println("ShoppingController:: client comp class name::"+consumer.getClass());
return "Pongal Shopping for Family ...."+consumer.fetchBillDetails();

}

}
```

step5:
Execute the application
==========

=>Run Eureka server app
=> Run the Producer MS application for 2 or 3 times with different port numbers changed in the application.properties file
=> Run the Cosumer Ms application
=> Go to Eureka Server Home page and modify the Cosumer SErvice url to as shown below

Pongal Shopping for Family ....we accept Card Payment , UPI Payment, NetBaking Payment, COD---> port::9902----InstanceId::Billing-Service:43c6cbdef49aebccda0ab868294114f4

Different pratices to develop Feign Client Interfaces
==========

Producer Ms / Target Ms
==========

a) ServiceId /applicaiton -name:: Vendor-Service

```
@RestController
@RequestMapping("/vendor")
public class VendorServiceController{
   @GetMapping("/all")
   public ResponseEntity<List<Product>>
                        getAllProducts(){
      ...
   }
}
```

Feign Client Interface at Cosumer MS
==========

a)

```
@FeginClient("Vendor-Service")
public interface IVendorServiceConsuner{
    @GetMapping("/vendor/all")
    public List<Product> fetchAllProducts();
          (or)

    @GetMapping("/vendor/all")
    public ResponseEntity<List<Product>> fetchAllProducts();

}
```

---

b) Service Id /app name :: Payment-Service

```
@RestController
@RequstMapping("/payment")
public class PaymentServiceController{

  @PostMapping("/save")
  public String saveCard(@RequestBody CarDetails details){
    ...
    ..
  }

  @DeleteMapping("/delete/{cardNo}")
  public String removeCard
          (@PathVariable Integer cardNo){
    ...
    ..
  }
```

```
@FeignClient("Payment-Service")
public interface IPaymentServiceRestConsumer{

  @PostMapping("/payment/save")
  public String addCard(@RequestBody CardDetails details);

  @DeleteMapping("/payment/delete/{cardNo}")
  public String deleteCard( Integer cardNo) ;

}
```

Assuming the front end app of Consumer MS sig giving JSON inputs

Assume Front End app is not giving json data.. to this Cosumer MS

Jan 17 Ms-Intra Communication (Feign Clent)

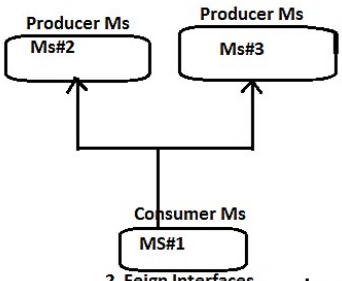
In MicroServices intra communication we need Client Type comps to find the SErvice Instance Details of Target Ms and to perform Http calls based communucation with taget MS/Producer MS from Consumer Ms.

Client Type comps are
a) Discovery Client
b) LoadBalacerClient (LBC)
c) Fiegn Client

=> if we have 1 producer - 1 consumer type of MicroServices using Feing client then we need to take 1 Feign Interface (@FeignClient) at Cosumer Ms side... if the the Conumer Ms is consuming the multiple Producer Ms services then we need to take multiple feign Interfaces.

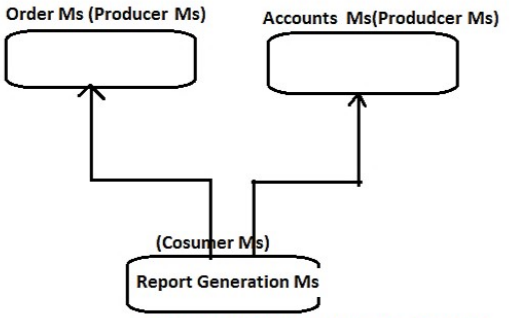
Feign Interface count = no.of producer Ms services consumed by Cosumer Ms

=> For example if MS#1 is consuming Ms#2 and Ms#3 producer services then Ms#1 consumer Ms should have 2 feign Interfaces as shown below



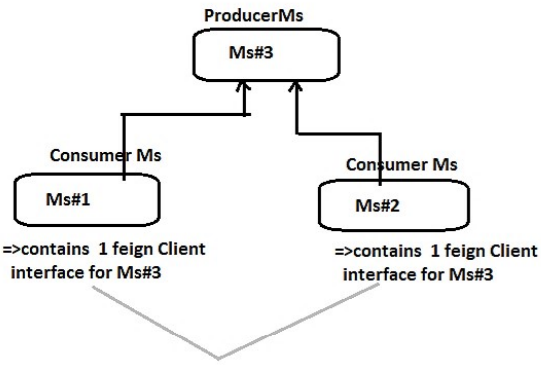
2 Feign Interfaces
=> 1 for Ms#2 service
=> 1 for Ms#3 service

In this Cosumer Ms we need to place 2 @FeignClient("....") annotations on two different feign interfaces having the two different service ids of two different producer Ms. But we need to place @EnableFeignCleints only for 1 time on Main class.



=>Contains 1 Feign Interface for Order Ms
=>Contains 1 Feign Interface for Accounts Ms

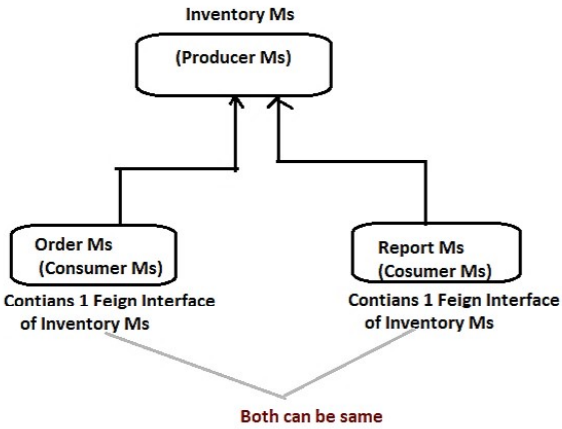
=> if one Producer Ms services are used by multiple consumer Ms then we may need to place same feign Client Interface in multiple consumer Ms.



=>contains 1 feign Client interface for Ms#3

=>contains 1 feign Client interface for Ms#3

(Both may be same interfaes)



Contians 1 Feign Interface of Inventory Ms

Contians 1 Feign Interface of Inventory Ms

Both can be same

Summary on ClientType comps

Client Type comp	support for Load Balancing	Required Annotation	Is Abstract Client or Concrete Client	industry standard or not	required dependnecy	operations
DiscoveryClient	no	@EnableEurekaClient (main class)	concrete client	not	Discovery Cleint	=>call getinstances(-) to get SService Instance and use RestTemplate to make http calls
Load Balancer Client	yes	@EnableEurekaClient (main class)	concrete client	not	Discovery Client	=>same as above but method is choose(-)
FeignCleint	yes	@EnableEurekaClient, @EnableFeignClents (main class) @FeignClient(---) (interface level)	abstract client (Intenrally InMemory proxy will be generated)	yes	Open Feign	=>The Inmemory Proxy class for @FeignClient interface will take of getting service Instance and making http calls

Spring Cloud Config Server
==========

jan 19 Spring Cloud Config SErver

=> It is also called Configuration server(CS) and this is useful to get common key=value pairs required for the multiple micro services from the common place.. i.e instead of placing same key=value pairs in multiple micro services .. we can place them in common place and we can get them through configuration server for multiple micro services

=> These common key=value pairs are generally DB conneection properties , email properties , security properties and etc.. which are required as same properties in multiple in MicroServices..

=> We place these common key=value pairs seperate properties file outside of all MicroServices Projects and we take seperate project for Configuiration Server having one application.properties and this file will be linked with that common/seperate properties file.

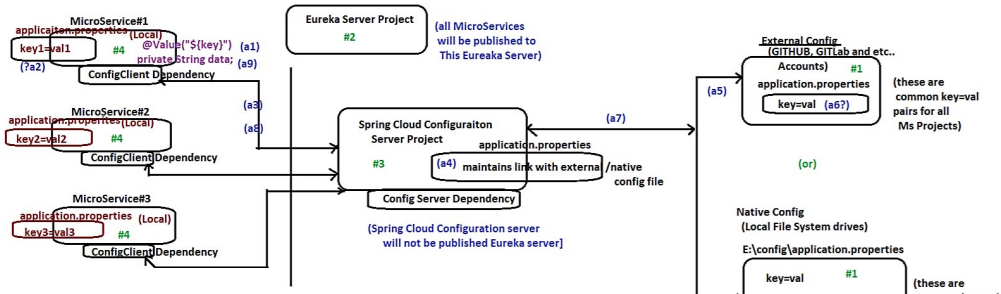
=> WE need to create Configuration server Project(Also a Ms Project) adding "ConfigurationServer" dependendency and this Configuration server by default runs on the Port number 8888.

=> We can make Configuration server Project getting common key=value pairs in two ways

(best) a) Using External Server Configuration (i.e we can place common properties file in GIT accounts like github, gitlab(best), bitbucket,..)
(Good for all env.. dev, test, uat, prod)

b) Using Native Server Configuration (i.e we can place common properties file in Local File System Drives like E:,D: drives and etc..
(Generally used in dev env.. bit)

=> The real micro service projects that want to use Configuration server managed common properties file content (key=value pairs) must be added with "Configuration Client " dependency.



==========

Example Application on using GitLab Account maintain External Config file through spring colud Config server

==========

step1) create application.proeprties (External config file) in Git Lab account

-> go gitlab.com
-> register/singup account , verify through email address

-> singin/Login to git lab account by submitting username,password that were created above

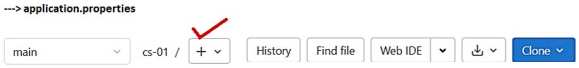
-> create new Project giving Project name
Menu bar ---> Projects ---> create new Project ----> Blank Project-->
project name :: CsProj1 --->select public ---> create project.

->add applicaiton.properties file in that Project
Go to home page CsProj1 ---> + ---> new file ---> application.properties

add --> key=value pairs

application.properties
---
dbuser=system
dbpwd=manager

commit .. chanages

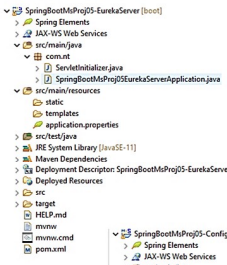


-> Gather GitLab account Project url
Go to CsProj1 home page ---> clone ---> gather url ::
https://gitlab.com/nataraz/csproj1.git
protocol domain gitlab username project name

step2) create Eureka server Project in Eclipse IDE
(add :: Eureka server as dependency ,spring web)

--> place @EnableEurekaServer on the top of main class
--> add the following entries in application.properties

```
# server port
server.port=8761

#disable registration and fetching
eureka.client.register-with-eureka=false
eureka.client.fetch-registry=false
```



step3) create Spring Cloud Configuration server Project (ConfingSeever Project)
(add Config server Dependency ,spring web)
(select from spring cloud config section)

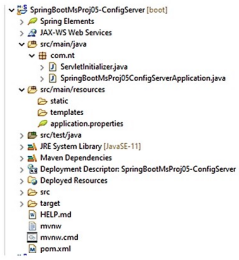
->add @EnableConfigServer on main class
-> add the following entries in application.properties file

```
# server port
server.port=8888
```

default server port no

```
# Provide Link to GitLib user account
spring.cloud.config.server.git.uri=https://gitlab.com/nataraz/csproj1.git
```

Link Url



step4) create Mutliple MicroService Projects having the following dependencies
a) spring web b) Discovery Client , c) Config Client (new)
(select from spring Cloud Config section)

Eureka

Ms#1

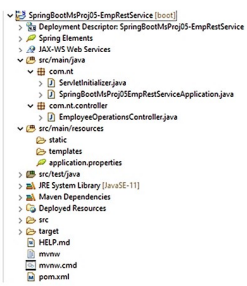
-> add @EnableEurekaClient on the main class
-> add the following entries in application.properites file

```
# server port (MS Port)
server.port=9900
# service name or applicaiton name
spring.application.name=EMP-SERVICE
#provide Eureka server Url to register EUreka server
eureka.client.service-url.default-zone=http://localhost:8761/eureka

#to make MS connecting to 8888 port no configurationServer(required from sprig boot 2.4 onwards)
spring.config.import=optional:configserver:
```

->Develop one RestConntroller conusuming the vlaues ot extenal config file (GibLab account application.properties file)

//controller class

```
package com.nt.controller;

import org.springframework.beans.factory.annotation.Value;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;

@RestController
@RequestMapping("/emp")
public class EmployeeOperationsController {

    @Value("${dbuser}")
    private String user;
    @Value("${dbpwd}")
    private String pass;

   @GetMapping("/show")
   public String showData() {
        return "Data Collected throgh Config Server ::"+user+"----"+pass;
    }
  }
```



jan 19.1 Spring Cloud Config SErver

#Ms2 application.properties

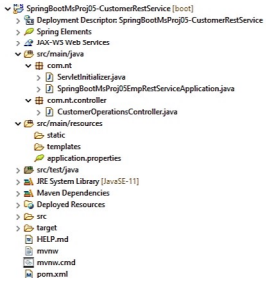
same as MS#1

add dependencies:-
a) spring web
b)config client
c)Eureka discovery client

(+) add @EnableEurekaClient on main class

```
# server port (MS Port)
server.port=9901

# service name or applicaiton name
spring.application.name=CUST-SERVICE

#provide  Eureka server Url to register  EUreka server
eureka.client.service-url.default-zone=http://localhost:8761/eureka

# To  make  Ms Connecting to 8888 port number ConfigurationSErver (required from spring boot 2.4 onwords)
spring.config.import=optional:configserver:
```

-> add @EnableEurekaClient on the main class




```
//CustomerOperationsController.java
package com.nt.controller;

import org.springframework.beans.factory.annotation.Value;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;

@RestController
@RequestMapping("/cust")
public class CustomerOperationsController {

    @Value("${dbuser}")
    private  String  user;
    @Value("${dbpwd}")
    private String pass;

@GetMapping("/display")
public  String   displayData() {
        return  "(Customer)Data Collected throgh Config Server ::"+user+"----"+pass;
}

}
```

We can use GITHUB , BitBucket also
External Configuration for Configuration
server using the same process.
note:: while working with GIT hub
there is no need of passing .git
in the link url of application.properties

step5) Run the Applications in the following order

->Run Eureka server Project
-> Run Config SErver Project
-> Run All Ms Projects

-> Go to EurekaSever Home page and modify the URL both
Emp, Cust Ms services

http://desktop-iudaavl:9901/cust/display ---> To generate request Cust Ms

http://desktop-iudaavl:9900/emp/show ---> To generate request Employee Ms

---

Making Multiple MicroSErvices getting common data from Native Config file (Local system drivers) With the support spring Cloud Configuration server

---

=> It is suitable only in Dev , Test env.. but not in UAT , production env..
=>Use this in dev, test env.. if u r not ready with GIT Accounts
=> Generally we place this Native Configuration related application.properties file
in the spring Cloud Configuration project itself (which also uses Local system Drives)

Example App
==========

step1) Develop Eureka Server App

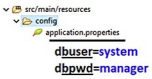
(same as previous App)

step2) Develop Confiauration SErver

(add Config server Dependency)
(select from spring cloud config section)

->add @EnableConfigServer on main class

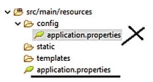
-> add new applicaiton.properties by creating a folder like "config" in src/main/resources folder
to keep common key=value pairs required for all Ms projects.



dbuser=system
dbpwd=manager

src/main/java , src/main/resources folders
of maven project will be placed in classpath
by default.

->add the following entries in application.properties file of src/main/resources folder




```
# server port
server.port=8888
#active native profile of its Parent Project
spring.profiles.active=native
# specify  "config"  folder of  classpath as NativeConfig Location for  Configuration Server
spring.cloud.config.server.native.search-locations=classpath:/config
```

Native Cofig Location

The Parent project of Configuration server is having profiles .. the default
profile is designed to get Linked with Git Accounts i.e taking Extenal Configuration
where as "native" profile is designed to get linked with Native Config (local drives)
So we are activating native profile.

step3) Develop Multiple MicroServices (MS#1 and MS#2)
(same as previous)
add dependencies===>

step4) Execute the Applications/Projects in the following order.

->Run Eureka server Project
-> Run Config SErver Project
-> Run All Ms Projects

-> Go to EurekaSever Home page and modify the URL both
Emp, Cust Ms services

http://desktop-iudaavl:9901/cust/display ---> To generate request Cust Ms

http://desktop-iudaavl:9900/emp/show ---> To generate request Employee Ms

Q:- how ConfigServer gets data of MS Projects properties file in the eureka server ..??

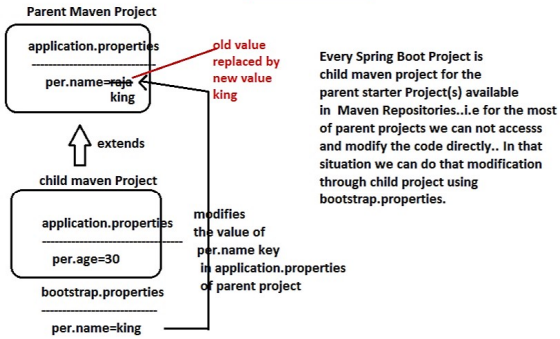
configServer is capable of getting the datails nothing but properties ke value pairs from Repository of external configServer project & we create that as public mode we can access & get details & can use in the required MS project

bootstarp.properties

jan 20 Spring Cloud Config SErver with Bootstrap Properties

if u want change the value of certain key belonging to parent project being from child project then the child project can use bootstrap.properties placed in the classpath like in src/main/resoruces folder.

=>Being from Child Maven Project.. if u r looking to change the parent Project's application.properties file values then use bootstrap.properties in the child project.



Q) What is default port number of spring Clould ConfigServer
ans) 8888

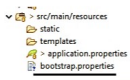
Q) What is spring Clould ConfigServer url/uri
ans) http://localhost:8888

Q) Can we change the Port the number of Config Server?
Ans) yes .. use the application.properties file of Config server project
server.port=8811
accordingly config server uri will change http://localhost:8811

Q) How can we connect to ConfigServer from Ms App if the Config Server is not running on the default port number?

step1) make sure Config SErver Port number is changed(server.port=8811)

step2) add bootstrap.properties in src/main/resources folder of Ms Project having config server uri as shown below.



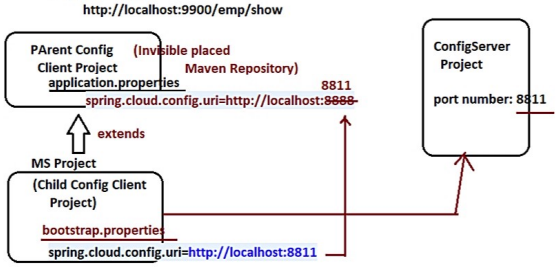
spring.cloud.config.uri=http://localhost:8811

step3) make sure that spring-cloud-starter-bootstrap dependency jar file is added to build path in the MS Project

```
<!-- https://mvnrepository.com/artifact/org.springframework.cloud/spring-
 cloud-starter-bootstrap -->
 <dependency>
   <groupId>org.springframework.cloud</groupId>
   <artifactId>spring-cloud-starter-bootstrap</artifactId>
 </dependency>
```

(collect from mvnrepository.com)

step4) Run the PRojects
=> Run EurekaServer
=> Run ConfigServer
=> Run Ms Project → after running this in log messages you'll see some message like `Fetching config from server at : http://localhost:8811`
=> Test Ms Project
http://localhost:9900/emp/show



=> While executing any Ms Project the bootstrap.proeprties will execute first and modifies parent project settings

---

Q) How can we connect to ConfigServer from Ms App if the Config Server is not running on the default port number?
(How can we do this work with out bootstrap.properties)

Ans) Possible by adding following entries in the application.properties file of MS Project reflecting the Changed port number /uri of Config Server.

application.properties

```
# To make Ms Connecting to certain port number ConfigurationSErver (required from spring boot 2.4 onwords)
spring.config.import=optional:configserver:http://localhost:8811
```

note:: Here no need of adding bootstarp.properties
adding spring-cloud-starter-bootstrap dependency → is mandatory or not is in confusion state

---

In Ms Project if we specify two different uris with two different port numbers of Config Server using both application.properties and bootstrap.properties then which will be taken?

Ans) Both uris will be taken but the application.properites file supplied uri will override the uri of bootstrap.properties file

Conclusion:-

Old Approach:- creating bootstrap.properties file and adding the line
`spring.cloud.config.uri=http://localhost:8866`

Modern Approach:- adding the line in already available properties file
`spring.config.import=optional:configserver:http://localhost:8811`

Jan 22 RefreshScope and Actuactors

Working with RefreshScope using @RefreshScope Annotation

=>The modifications GitLab /GITHUB Extenal Config file content will reflect to all the MicroServcies olnly when we restart the Config serrver and all Ms .. But Restrating Configserver and all Ms every time for each modification done in External Config is a not recomanded process.

=>To overcome that problem we can use RefreshScope (@RefreshScope) with support of spring boot Actuators (readymade endpoints /ready made Microservices given by spring boot)

Procedure to work @RefreshScope

step1) spring boot actuator dependency to our MS Project (EmpRestSErvice kind of Project) (Config Client)

```
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-actuator</artifactId>
</dependency>
```

right click on project ---> properties ---> spring ---> add starter ---> search for actuator and select spring boot actuator.

step2) Activate the readymade actuator "refresh" in our MS Project (Config Client) adding the entries in application.properties

In application.properties

```
# Activate all actuators (*) or only refresh actuator
management.endpoints.web.exposure.include=*  (additional entry)
```

step3) place @RefreshScope on the top RestController of In Ms Project

```
@RestController
@RequestMapping("/emp")
@RefreshScope
public class EmployeeOperationsController {
    ...
    ....
    ....
}
```

step4) start Eureka Server ,Config Server , MsProject in regularfashion

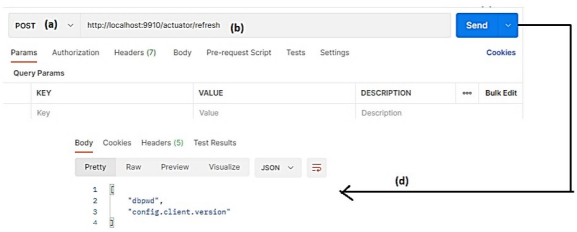
step5) Test the Ms using the regular url http://desktop-iudaavl:9910/emp/show

step6) Modify entries in application.properties file of GitLab account (External Config file) open properties file in git lib --> edit web editor ----> ....

step7) Test the MS using regular url http://desktop-iudaavl:9910/emp/show (Modifications does not reflect suprisingly)

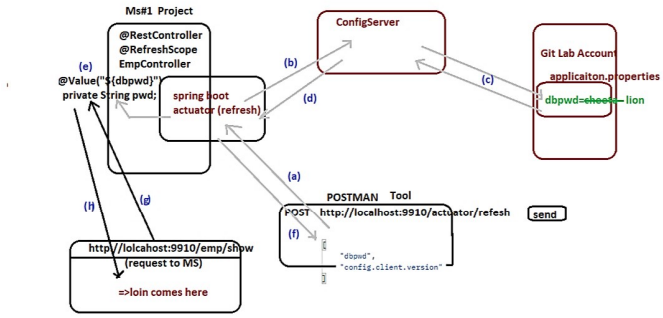
step8) Gather EndPoint details of "refresh" spring boot actuator and given POST mode request to it using POSTMAN tool.

"refresh" actuactor url is http://localhost:9910/actuator/refresh



step9) Test the MS using regular url

http://desktop-iudaavl:9910/emp/show
(chanages will reflect)



spring Boot Actuactors

Spring Boot Actuators

Production Sever :: The Server in which Application is deployed to give services to endusers for commercial use is called Production Server. This Server manages Live Code and Live DB..

Old days :: Dedicated high end System for Producttiion Server

recent days :: using Cloud env (rental basis infrastructure) like AWS , Google Cloud and etc..)

Production Enviroment /Setup :: The s/w's and tools that are used in production server to deploy and run the App is called Production env/setup

eg:: jdk s/w , wildfly server/Tomcat server , jenkins, Docker and etc..

EndPoint :: The Rest apis /Rest Service /some other service that is ready to use is called Endpoint.. In order take the services from any EndPoint we need gather End point details like url , method type , path variables and etc..

=>Each RestController we develop spring boot App is called one Endpoint and to use that endpoint we need to the above said details

eg : http://localhost:9910/emp/show (URL) , GET (method type) , {id} , {name} are path variables, Input type : JSON, output type: String and etc..

Spring Boot Actuator :: It is production ready endpoint (buit-in Rest Service) given by spring boot people to perform non-functional operations on the production env.. spring boot project.

eg :: health , info , configprops ,beans ,logging, refresh and etc.. (generally we get 13+ ready made actuators)

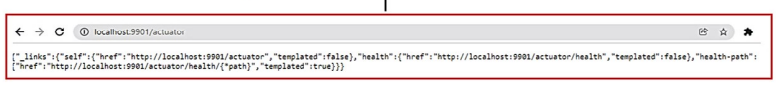
=> Upto spring boot 2.5 we used to see two actuators as activated/enabled actuators by default they are health, info
=> From spring boot 2.6 they are giving only health as defaultly activated actuators.

=> In any Ms Project add "spring boot actuators" dependency in order use spring actuator services.

```
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-actuator</artifactId>
</dependency>
```

Right click spring boot project --> spring --> add starter --> select spring boot actuator

URL to see all the defaulty activated actuators
http://localhost:9901/actuator
Current App port number



Jan 22.1 RefreshScope and Actuactors

Example app

==========

=> create Spring Boot Starter Project (As RestService / Not As MicroService) adding web , actuator dependencies
(No need of adding DiscoryClient, Config Client)

=> Developе RestController as shown below

```
@RestController
@RequestMapping("/cust")
public class CustomerOperationsController {
    @GetMapping("/display")
    public String displayData() {
        return "(Customer)Customer Info will be displayed here .. welcome Call Center ";
    }
}
```

=> add following entries in application.properties

```
# server port (MS Port)
server.port=9901
# service name or applicaiton name
spring.application.name=CUST-SERVICE
```

=> Run the App as spring boot App

=> get the defaultly activated list of actuactors.

type the url http://locahost:9901/actuator


```
{"_links":{
"self":{"href":"http://localhost:9900/actuator","templated":false},
"health":{"href":"http://localhost:9900/actuator/health","templated":false},
"health-
path":{"href":"http://localhost:9900/actuator/health/{*path}","templated":true}
}}
```


this is again copied and simplified from webpage of that url to readable and as it is given before this example code

(the data is coming in the form of JSON format)

---

health

=> This actuator gives health metrics info like Currenet App is up or down

=>Using this actuator we can also get more detais related memory like Diskspace , free space used space and etc..

=> It is defaulty activated spring boot actuator.

=>These actuators services are very useful for Project maintainace team generally that is DevOps Team

=>To get memory details about the application we need to add one more supporting entry in application.properties.

In application.properties

```
#To get Memory details default using health actuator
management.endpoint.health.show-details=always
```

(the possible values are always,never(default), when-authorized)


```
{"status":"UP","components":{"diskSpace":{"status":"UP","details":{"total":185532936192,"free":145165168640,"threshold":10485760,"exists":true}},"ping":{"status":"UP"}}}
```


```
management.endpoint.health.show-details=always
    (always gives health metrics(Memory details) though u have not logged to the App)
management.endpoint.health.show-details= never
    (Does not give health metrics)
management.endpoint.health.show-details= when-authroized
    ( gives health metrics(Memory details) only for the logged in user of the App i.e authentication and authorizations are completed.)
```

To disable any atcuator

In application.properties

```
management.endpoint.<endpoint-id>.enabled=false
                                    (default is true)
```

these are like health, beans,info and etc..

To enable certain actutor which is not activated by default

In application.properties

```
management.endpoints.web.exposure.include=info
    (Activates only info actuator)

management.endpoints.web.exposure.include=info,health
    (Activates only info,health actuators)

management.endpoints.web.exposure.include=*
    (Activates all the actuators)
```

when all actuators are activated the list looks like this


```
{"_links":{"self":{"href":"http://localhost:9901/actuator","templated":false},"beans":{"href":"http://localhost:9901/actuator/beans","templated":false},"caches":
{"href":"http://localhost:9901/actuator/caches","templated":false},"caches-cache":{"href":"http://localhost:9901/actuator/caches/{cache}","templated":true},"health":
{"href":"http://localhost:9901/actuator/health","templated":false},"health-path":{"href":"http://localhost:9901/actuator/health/{*path}","templated":true},"info":
{"href":"http://localhost:9901/actuator/info","templated":false},"conditions":{"href":"http://localhost:9901/actuator/conditions","templated":false},"configprops-prefix":
{"href":"http://localhost:9901/actuator/configprops/{prefix}","templated":true},"configprops":{"href":"http://localhost:9901/actuator/configprops","templated":false},"env-
toMatch":{"href":"http://localhost:9901/actuator/env/{toMatch}","templated":true},"env":{"href":"http://localhost:9901/actuator/env","templated":false},"loggers-name":
{"href":"http://localhost:9901/actuator/loggers/{name}","templated":true},"loggers":{"href":"http://localhost:9901/actuator/loggers","templated":false},"heapdump":
{"href":"http://localhost:9901/actuator/heapdump","templated":false},"threaddump":{"href":"http://localhost:9901/actuator/threaddump","templated":false},"metrics-
requiredMetricName":{"href":"http://localhost:9901/actuator/metrics/{requiredMetricName}","templated":true},"metrics":
{"href":"http://localhost:9901/actuator/metrics","templated":false},"scheduledtasks":{"href":"http://localhost:9901/actuator/scheduledtasks","templated":false},"mappings":
{"href":"http://localhost:9901/actuator/mappings","templated":false}}}
```


Info

=>Gives info about current application in the form JSON content when user request to this "info" atuator gives

=>For that we need to maintain information about application in application.proeprties file having fixed prefixes in keys (the is info.app)

example

=> keep spring rest app ready (same as previous)

=> activate "info" or all actuators

In application.properites

---

management.endpoints.web.exposure.include=info (or) management.endpoints.web.exposure.include=*

=> add more info about the application. in application.properties having fixed prefix in keys (info.app)

In application.properties

```
# info about application
info.app.name=CUST-Service
info.app.id=45467
info.app.size=10modules
info.app.vendor=Naresh IT
info.app.createdBy=Team-S
```

To disable info actuator management.endpoint.info.enabled=false

=> enable info enviorment to read about current app

In application.properties

```
management.info.env.enabled=true
```

=>Test the info acuator Application


```
{"app":{"name":"CUST-Service","id":"45467","size":"10modules","vendor":"Naresh IT","createdBy":"Team-S"}}
```


---

jan 24 Spring Boot Actuactors

What is the benifit of spring boot actuators ?

=>These are non-functional features that required in any project's deployment and maintainance .. Earlier teams used dependent various tools given by jdk and thirdparty to get these non-functional features..

=>For example when bug is raised we need logging info and threaddump info
Earlier people have used seperate logging tools like log4j , slf4j and etc..
also seperate thread dump tools like jconsole , JMC , jstack ,Visual Vm and etc..
After the arrival of spring boot .. we can use actuators support like logging , threaddumps for same.

url To get all actuators:- http://localhost:9901/actuator

List of imp actuators

health ,info , configprops , mappings, threaddump, heapdump, env, beans, refresh loggers , scheduledtasks,cache,metrics

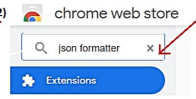
beans :: Gives info about all spring beans of current spring boot App (Both AutoConfigured and manually configured)

URL :: http://localhost:9901/actuator/beans

How to add Json Formatter Extension to chrome?

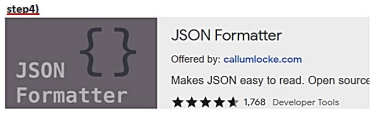
step1) in chrome search for chrome web store and open the home page of chrome web

step2)



step3) search for json formatter

step4)



step5) click on Add to Chrome

---

configprops :: Gives all the @ConfigurationProperties based key=value loadings done both user-defined and pre-fined spring bean classes.

http://localhost:9901/actuator/configprops

env :: Gives the current env.. of the Project in the form of key=value pairs like jars files added classpath , cpu details , os details and etc..

http://localhost:9901/actuator/env

loggers :: Gives all log messages related details along withe their logging levels.

http://localhost:9901/actuator/loggers

scheduledtasks : Gives all @Scheduled methods info like initialDelay , fixedDelay,fixedRated, cron and etc.. details

threaddump :: Gives info about all the daemon threads(backgrounds) that are created running continusoly

http://localhost:9901/actuator/threaddump

mappings :: gives info all handler methods , RestController methods mappings info like request path , method name, method signature , method type and etc..

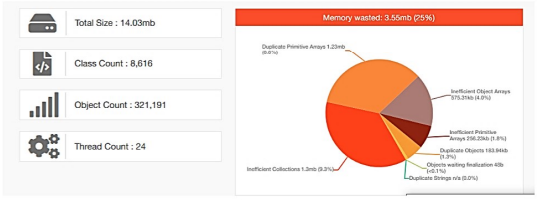
http://localhost:9901/actuator/mappings

heapdump :: Gives gives heapdump (memory details) in the form downloade byte code info..
So we need addtional tools to analyze that content like Eclipse Memeory Analyzer , IBMheapMemoryAnalyzer , heap hero and etc...

http://localhost:9901/actuator/heapdump ⟶ gives "heapdump" file in downloads folder havig byte /machine code

To analyze the heap dump

go to https://heaphero.io/ ⟶ select the above heapdump file ⟶ get the analyzation report



caches :; gives info all CacheManagers that are configured in different parts of the application.

http://localhost:9901/actuator/caches

metrics :: gives Info about properties list related to current project.

http://localhost:9901/actuator/metrics

What is the base path for actuators?

nothing but url to see actuators:- http://localhost:9901/actuator

Can we change the basepath of actuator?

=>Like changing context path of web application.. we can also change basepath or context path of actuators

in application.properties

```
# To change basepath of actuctors
management.endpoints.web.base-path=/nitinfo
```

To test the change

http://localhost:9901/nitinfo
http://localhost:9901/nitinfo/health
http://localhost:9901/nitinfo/beans

note:: we can not take "/" as the basepath for actuators becoz it is already assigned to DispatcherServlet.

Q) While working with "refresh" actuator if Extenal Config file (GitLab account file) and local application.proeprties file of the MS project contains same keys with different values Can u tell me which value will be injected.

GitLab's application.properties

```
dbuser=system
```

local application.properties

```
dbuser=ramesh
```

In Ms App

```
@Value("${dbuser}")
private String user; -- gets what value :: system
```

(takes from External ConfigServer)

jan 25 CircutBreaker In Spring Boot Ms

Circut Breaker in spring Boot MicroSErvices

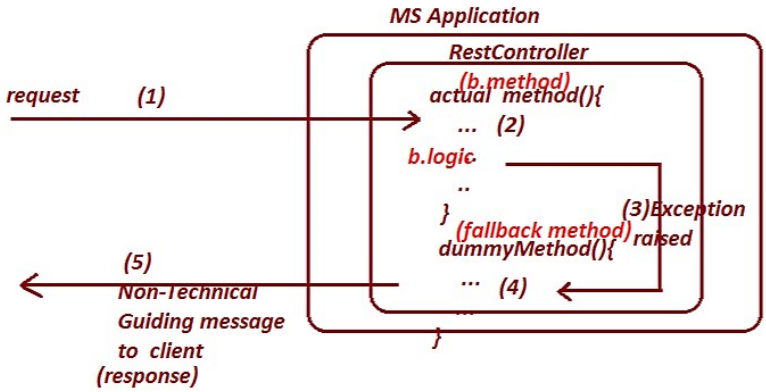
==========

=> if the method b.method of Application is continuosly throwing exception then avoid execution of actual b.method logic and provide dummy response or non-technical guiding response to Client is called working with fallback method with circut breaker.

What is fallback method?

=> The method the executes automatically when the exception raised in the actual b.method to provide non-technical guiding messages to enduser is called fallback method.

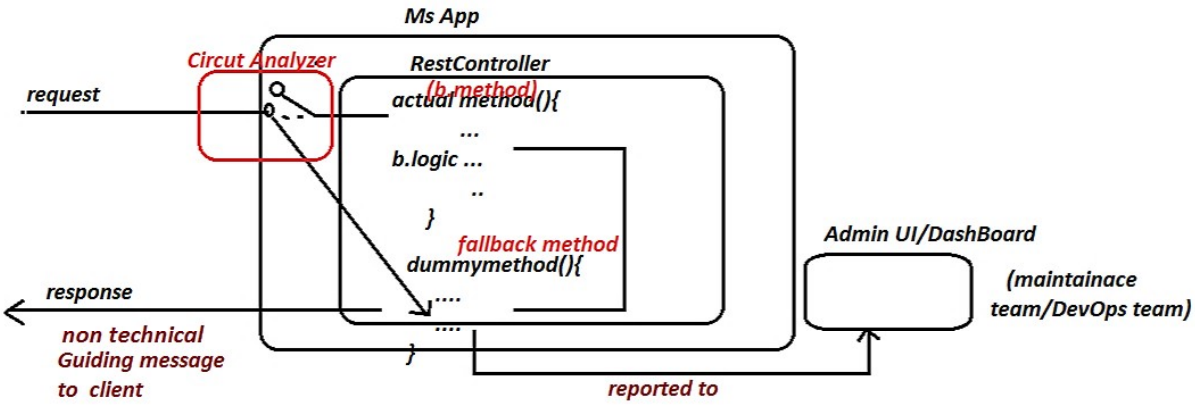
The non-technical guiding messages are " Service not found " , "please try after some time" "Inconvience regratted" , " service down due technical issues" , " site on maitainace" and etc..



What is fallack method with Circuit breaker support?

if the actul b.method of the application is continuosly throwing exception.. then avoid sending request b.method for some amount of time and make DispatcherSErvlet kind of FrontController redirecting request of actual b.method to dummy fallback method again for certain amount of time is called fallback method with circut breaker.

=>let us assume the actual b.method has thrown exception for 20 times already and the fallack method is executed .. if circut breaker concept is added the next few requests given actual method directly goes to dummy method for certain amount of time . this is called fallback method with circuit breaker.



case1:: actual method has got 20 requests and all of thrown exception so fallback methid is executed (only fallack method)

case2: after 20 times exeception raising continuosly(back to back) in actual method the next requests given to actual method goes to fallaback directly to deliver non-technical guidling messages for some amount time .. after that case1 repeates (fallback with circuit breaker)

jan 25.1 CircutBreaker In Spring Boot MS

Two types of Circuits on Circuit Breaker with Fallback method mechansim

==========

(a) Open Circuit :: It indicates that the b.method had continuosly throws exception (back to back) So circut to b.method is broken (open) for client requests.. So client request will redirect to dummy fallback method as shown in the diagram for certain amount of time

(b) Closed Circuit :: It indicates the request given by client goes to b.method directly

Realtime use-cases for Circuit breaker impl ::

a) card payment b) Online flash sale c) online exam results d) online ticket booking and etc..

=>To implement Circut breaker concept in Spring Boot Ms we need to use spring Boot hystrix implementation given by nextfilx For this we need two annotation

a)**@EnableHystrix** on the top of Main class

b)**@HystrixCommand** on the top of actual b.method specifying the dummy method name

Example App on fallback method

==========

step1) create spring boot Project adding web , hystric starters.
(Choose spring boot version as <=2.3)

note : Latest versions of spring boot not support netflix hystrix .. so use resilliance4j as the alternate

```
<dependency>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-starter-web</artifactId>
</dependency>
```

```
<!-- https://mvnrepository.com/artifact/org.springframework.cloud/spring-cloud-starter-
netflix-hystrix -->
<dependency>
  <groupId>org.springframework.cloud</groupId>
  <artifactId>spring-cloud-starter-netflix-hystrix</artifactId>
  <version>2.2.10.RELEASE</version>
</dependency>
```

step2) add @EnableHystrix on the main class

step3) Develop RestController as shown below having b.method and dummy method

```
@RestController
@RequestMapping("/ticket")
public class TicketBookingRestController {

    @GetMapping("/book")
    @HystrixCommand(fallbackMethod = "dummyBookTicket")
    public String bookTicket() {
        System.out.println("TicketBookingRestController.bookTicket()");
        if(new Random().nextInt(10)<5)
            throw new RuntimeException("Problem is b.logic");

        return "output from b.logic";
    }

    public String dummyBookTicket() {
        System.out.println("TicketBookingRestController.dummyBookTicket()");
        return "Place Try later -- Inconvience is regratted";
    }

}
```

This dummy fallback method must be there is same class that to not having any parameters.

step3) Run the App and Test the Application.

http://localhost:9901/ticket/book

jan 27 CircutBreaker -Hystrix DashBoard

=>Spring Boot circuit breaker is the concept and implementations netflix hystrix and resilience4j

=> with respect to hystrix implementation

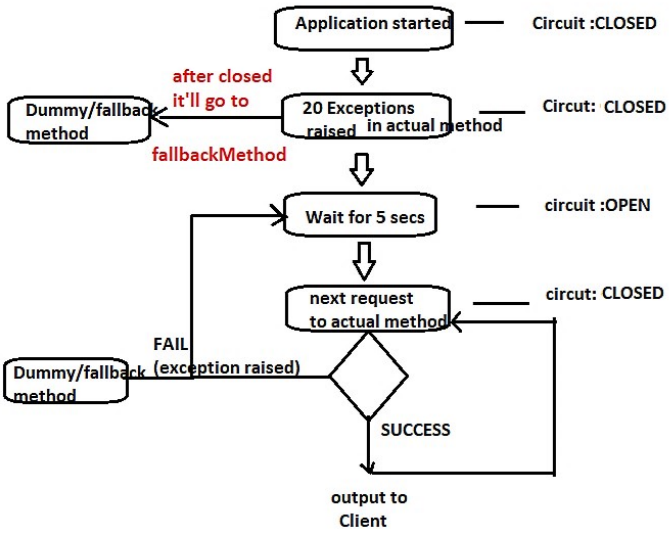
=>When the Applicaiton is started the Circuit will remain closed i.e intially request goes to atual method

=>The default exception count is : 20 (After raising exception for 20 times by actual method the curcuit will open)

=> The default retry-time is :: 5 sec (after getting 20 exceptions the circuit will open next 5sec i.e request will go to fallback method directly in these 5 secs and circuit will be closed after this 5 sec)

request

=> Once Circuit is ReClosed .. the next goes to actual method .. if exception is raised the circuit will be again opened for 5 secs .. and so on...



Example1 (fallbackMethod with Circuit Breaker)

step1) create spring boot project taking version as 2.3.6.RELEASE and adding web , netflix hystrix dependencies

step2) add @EnableHystrix on the main class

step3) Develop RestController having @HystrixCommand to specify dummy fallback and to enable circuit breaker

```
package com.nt.controller;

import java.util.Random;

import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;

import com.netflix.hystrix.contrib.javanica.annotation.HystrixCommand;
import com.netflix.hystrix.contrib.javanica.annotation.HystrixProperty;

@RestController
@RequestMapping("/ticket")
public class TicketBookingRestController {
      int count=0;

     @GetMapping("/book")
     @HystrixCommand(fallbackMethod = "dummyBookTicket",
         commandProperties = {
                        @HystrixProperty(name="circuitBreaker.enabled", value="true")
                    })
      public  String   bookTicket() {
            System.out.println("TicketBookingRestController.bookTicket()");
             if(new Random().nextInt(10)<10)
                   throw new RuntimeException("Problem is  b.logic");
              return "output from  b.logic";

      }

      public  String dummyBookTicket() {
            count++;
            System.out.println("TicketBookingRestController.dummyBookTicket()::"+count);
            return "Place Try later -- Inconvience is regratted";
      }

}
```

enables the circuit breaker

jan 27.1 CircutBreaker -Hystrix DashBoard

step4) give 20 to 3 contionuos requests to RestController from brrowser observe server consoe

http://localhost:9901/ticket/book

```
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::1
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::2
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::3
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::4
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::5
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::6
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::7
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::8
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::9
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::10
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::11
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::12
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::13
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::14
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::15
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::16
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::17
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::18
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::19
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::20
TicketBookingRestController.dummyBookTicket()::21
TicketBookingRestController.dummyBookTicket()::22
TicketBookingRestController.dummyBookTicket()::23
```

Circuit is closed for 20 exceptions So acutal is executing becoz of exception that is riased control is going to fallback method.

for 5 sec only fallback executes becoz the circuit open

Hystrix Command properties

For hystrik command properties
---
https://www.logicbig.com/tutorials/spring-framework/spring-cloud/hystrix-configuration-properties.html

```
@RestController
@RequestMapping("/ticket")
public class TicketBookingRestController {
	int count=0;

	@GetMapping("/book")
	@HystrixCommand(fallbackMethod = "dummyBookTicket",
		commandProperties = {
				@HystrixProperty(name="circuitBreaker.requestVolumeThreshold", value="5"),
				@HystrixProperty(name = "circuitBreaker.sleepWindowInMilliseconds", value = "10000"),
				@HystrixProperty(name = "circuitBreaker.enabled", value = "true")
					}
		)
	public String bookTicket() {
		System.out.println("TicketBookingRestController.bookTicket()");
		if(new Random().nextInt(10)<8)
			throw new RuntimeException("Problem is b.logic");

		System.out.println("End of Ticket Booking Opeation");
		return "output from b.logic(Success)";
	}
	public String dummyBookTicket() {
		count++;
		System.out.println("TicketBookingRestController.dummyBookTicket()::"+count);
		return "Place Try later -- Inconvience is regratted";
	}
}
```

circuitBreaker.requestVolumeThreshold :: *allows us to specify exception count (default is 20)*

circuitBreaker.sleepWindowInMilliseconds :: *allows to sepcify retry sleep time (default is 5 sec)*

circuitBreaker.enabled :: *allows us to specify wheather circuit beaker should be enabled or not (default is false)*

step4) give 5 to 6 contionuos requests to RestController from brrowser observe server consoe

http://localhost:9901/ticket/book

```
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::1
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::2
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::3
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::4
TicketBookingRestController.bookTicket()
TicketBookingRestController.dummyBookTicket()::5
TicketBookingRestController.bookTicket()
End of Ticket Booking Opeation
TicketBookingRestController.dummyBookTicket()::6
TicketBookingRestController.dummyBookTicket()::7
TicketBookingRestController.dummyBookTicket()::8
TicketBookingRestController.dummyBookTicket()::9
TicketBookingRestController.dummyBookTicket()::10
```

becoz of circut is closed

becoz of circuit is open

jan 28 Hystrix DashBoard and Resiliance4J

Hystrix DashBoard

=>It is given to provide GUI env.. to know current running MS details and its Circuit Breaker Details like checking wheather Circuit is open or close.

=>Since hystrix is kept in maintainace mode or deprecated mode in latest spring boot version , we need to use bit old spring boot versions like <2.4

=> For this we need to add new dependencies like hystrix dashboard and we need to place @EnableHystrixDashboard on the main class /starter class..

=>CircuitBreaker concept Desing Pattern to resovle the issues related to fault tolerance.

=>Circuit breaker concept says when there is possibility of getting error while using certains microservice locally or remotely .. then make request going certain fallback method after getting certain count of continuos exceptions/errors from the actual method... This avoid wastage of resources like CPU utilization or network intrastructure and etc..

Example

step1) create spring boot project adding web , hystrix , hystrix dashboard,actuators as dependencies..

from mvnrepository,com

```
<!-- https://mvnrepository.com/artifact/org.springframework.cloud/spring-cloud-starter-netflix-hystrix -->
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-netflix-hystrix</artifactId>
    <version>2.2.10.RELEASE</version>
</dependency>

<!-- https://mvnrepository.com/artifact/org.springframework.cloud/spring-cloud-starter-netflix-hystrix-dashboard -->
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-netflix-hystrix-dashboard</artifactId>
    <version>2.2.10.RELEASE</version>
</dependency>
```

from list of starters

```
<dependency>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-starter-actuator</artifactId>
</dependency>

<dependency>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-starter-web</artifactId>
</dependency>
```

step2) modify or add spring cloud version in pom.xml file and perform maven update

```
<properties>
    <java.version>11</java.version>
    <spring.cloud.version>Hoxton.SR4</spring.cloud.version>
</properties>
```

To make the project compitable with hystrix dashBoard.

step3) add @EnableHystrix , @EnableHystrixDashBoard on main class.

step4) Develop MS as RestController having @HystrixCommand to specify fallback method

```
@RestController
@RequestMapping("/ticket")
public class TicketBookingRestController {
 int count=0;
@GetMapping("/book")
@HystrixCommand(fallbackMethod = "dummyBookTicket",
                commandProperties = {
                @HystrixProperty(name="circuitBreaker.requestVolumeThreshold", value="5"),
                @HystrixProperty(name = "circuitBreaker.sleepWindowInMilliseconds", value = "10000"),
                @HystrixProperty(name = "circuitBreaker.enabled", value = "true")
                                    }
                )
public String bookTicket() {                                        //same as previous class
      System.out.println("TicketBookingRestController.bookTicket()");
       if(new Random().nextInt(10)<8)
            throw new RuntimeException("Problem is b.logic");

       System.out.println("End of Ticket Booking Opeation");
       return "output from b.logic(Success)";

}

public String dummyBookTicket() {
      count++;
      System.out.println("TicketBookingRestController.dummyBookTicket()::"+count);
      return "Place Try later -- Inconvience is regratted";
}

}
```

jan 28.1 Hystrix DashBoard and Resiliance4J

step4) Add addtional properties in application.properties fil;e

application.properties

```
server.port=9901

#enable actuators
management.endpoints.web.exposure.include=*

# enable hystrix streaming list
hystrix.dashboard.proxyStreamAllowList=*
```

step5) Run the Application.. (Test through DashBoard)

a) give reqeust to MS

http://localhost:9901/ticket/book

b) open dashboard of hystrix

http://localhost:9901/hystrix

enter following url related to our app below the image of dashboard

1

Hystrix Dashboard

http://localhost:9901/actuator/hystrix.stream

Cluster via Turbine (default cluster): https://turbine-hostname:port/turbine.stream
Cluster via Turbine (custom cluster): https://turbine-hostname:port/turbine.stream?cluster=[clusterName]
Single Hystrix App: https://hystrix-app:port/actuator/hystrix.stream

Delay: 2000 ms Title: Example Hystrix App

Monitor Stream ***2***

c) gives multiple requests our MS application using browser (refresh button) and observe the hystrix dash board messages

http://localhost:9901/ticket/book

---

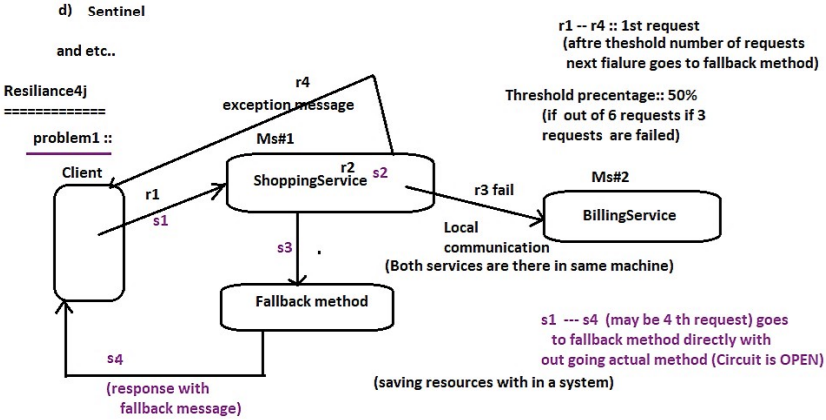
spring cloud Circuit Breaker Impl using resilience4J

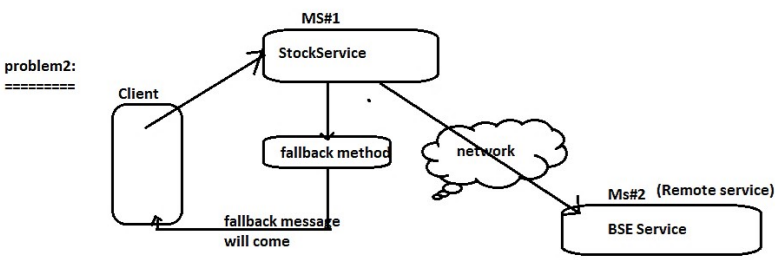
=>spring cloud circuit breaker concept is given as design pattern for fault tolerance settings and that is implemented by different vendors

a) Netflix hystrix (upto spring boot 2.3)
(deprecated in 2.4 and later removed)
b) Resiliance4j (from 2.4)
(Latest)
c) spring retry

d) Sentinel

and etc..





Saving resources of Ms System and alos network resources.

To solve the problem problems .. we can take the support resiliance4j which keeps circut in 3 states

=>Closed state :: success ---> dest Ms is executing through actual method soruce Ms
=> Open state :: After Threshold percentage is statisfied The circut will open and does not attempt to talk with dest comp
=>Half open state :: after staying open state for certain amount time it comes to Half open state to check actual Service is ready by generating internal implicit requests.. if ready .. the goes closed state.. if not ready goes to again open state.

feb 01 Messaging Intro - Feb1st 2022

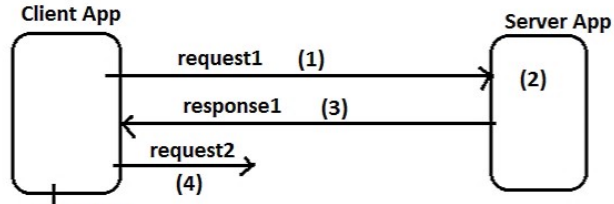
Messaging (Communication using Messages)
==========

The Client - Server Communication is of two types

a) Synchronous communication
b) Ashynchronous Communication

a) Synchronous communication

In this communication, the client App can send next request to Server App only after getting the response for the already given request i.e The Client App should wait for given request related response from server App in order to make it next request to server App or to perform some client side operations.



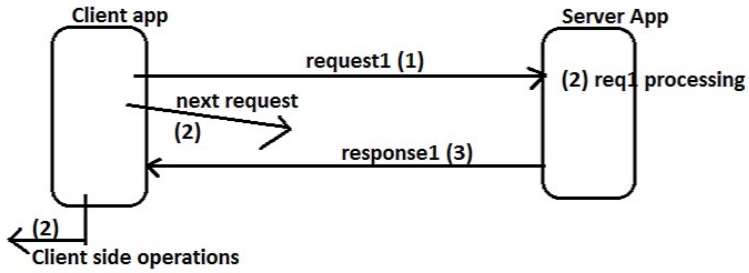
in synchrnous communication .. both Client App and server App must be active at time

Here the Client App is blocked to generate next request or to perform client side operations until given request related response comes back from server App.

note:: By default all Client - server communications are synchronous communincations

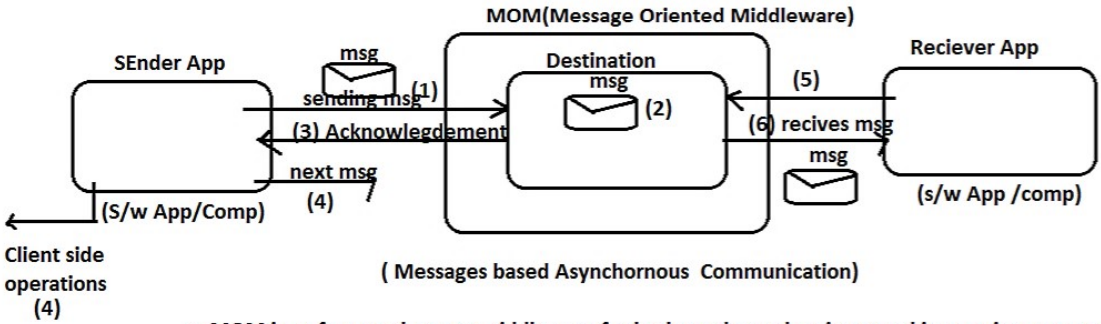
b) Ashynchronous Communication

=>Here Client App is free (not blocked) to generate the next request or to perform client side operations with out waiting for the given request related response from server App..



=>In web applications we can use AJAX (Asynchronous Java Script and Xml) to asynchrnonous communication b/w browser(Client) and web application(server) (now ajax is part of UI Technologies)

=> we can use "Messaging concept" (Messages based communication) to get Asynchronous communication b/w two software Apps /comps.



(Messages based Asynchornous Communication)

=> MOM is software that acts middle man for both sender and reciever and it contains memory called Destination to hold messages sent by sender App and to deliver the same messages to the Reciver App

note :: In Messaging the messages will go from one App to another App in continuos flow like stream.

note :: SMS messaging, whatup messaging , mailing does not come under messages based communication becoz that deals with person to person communication.. the actual messaging takes place b/w two software Apps or comps.

feb 01.1 Messaging Intro - Feb1st 2022

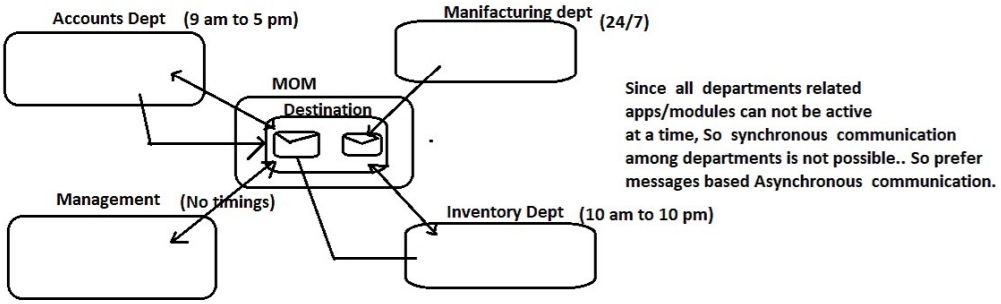
use-cases for Messaging ::
==========

a) Data streaming based on Scheduled /continous Flow
(eg:: uber cab availability status , Goods delivery App store availabiity status , Live Train Running status , Live cricket score status and and etc..)

b) Web activities and serach results
(eg: The advertisement agecy App gathers google search queries continuosly to Aggregate search queries)

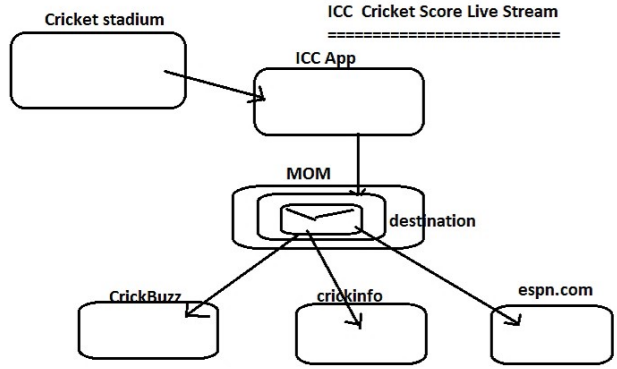
c) Log Aggregation
(eg:: Collecting log messages generated by Production env. App and aggregrating their those messages)

Car manifacturing company
==========



Since all departments related apps/modules can not be active at a time, So synchronous communication among departments is not possible.. So prefer messages based Asynchronous communication.

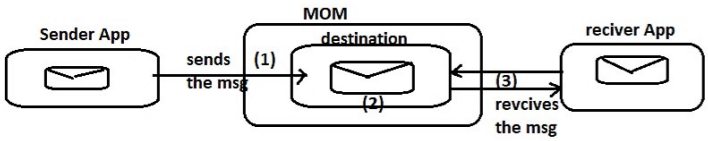
ICC Cricket Score Live Stream
==========



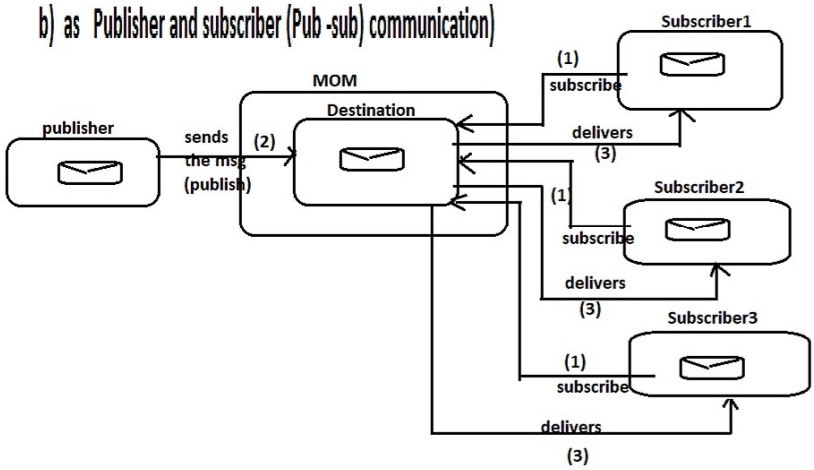
This Messaging based communication can be done in two ways
a) as Point to Point (PTP) communication
b) as Publisher and subscriber (Pub -sub) communication)

a) as Point to Point (PTP) communication

=>Here each message send to destination by sender will have only one consumer/Reciver i.e once consumer consumes the messages the message will be removed from the destination.



b) as Publisher and subscriber (Pub -sub) communication)



=> Here each messages sent by the publisher will go multiple subscribers who have done their subscription to destination before publisher publishes the message.
(each message can have 0 or more subscribers)

feb 02 Messaging using JMS

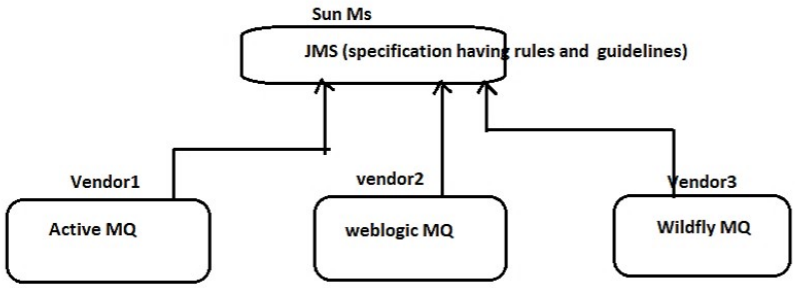
=> By Default all Client app -server app communication is synchronous communication
eg:: browser to web application , Rest Client to Rest Service , Ms Client to Ms , MS to MS.
=> In web application to get asynchronous communication b/w browser and web application take the support of AJAX .
=> Between two Java Apps or two MS or Rest Client And RestService if u r looking for Messages based asynchronous communication then for Messaging/Message Quees with the support of MOM software.

=> Messaging /Message Queue can be implemented using two types of porotocols
a) Using Basic MQ Protocol (BMQP) :: For this we need to use JMS
b) Using Adavanced MQ protocol (AMQP) :: For this we need to use RabitMq, Apache kafka and etc..

==========
Messaging /Message Queue using JMS
==========

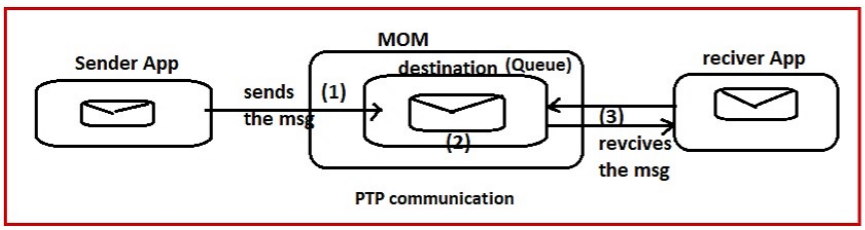
jakarta
(JMS :: ~~Java~~ Messsaging Service)
Java Mail Api is different from JMS

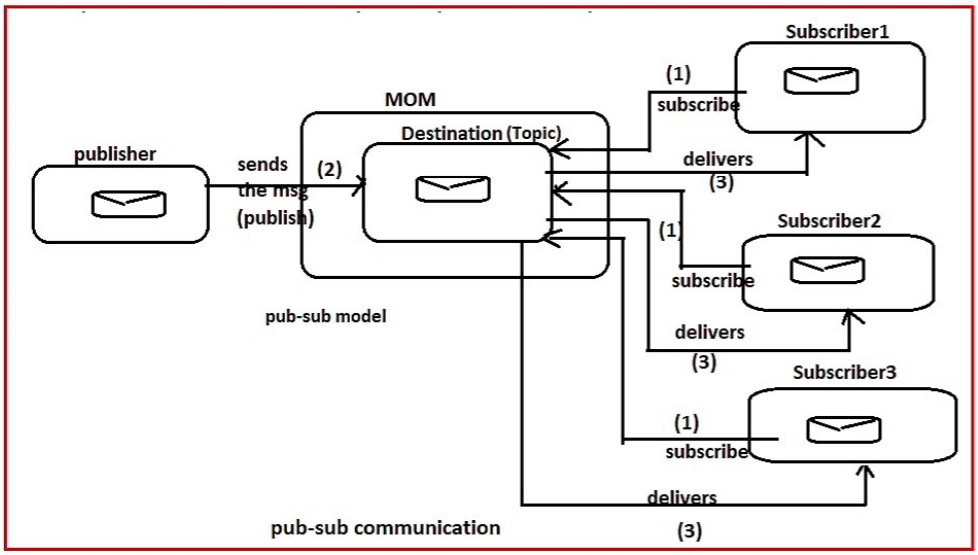
=> JMS is the software specification given by Sun Ms in JEE module having set of rules and guidelines to provide messsages based communication b/w java comps or Apps.



=> Each Implementation software of JMS given by different vendors is called one MOM software
=> Every Application server s/w like weblogic , wildfy and etc.. given one built-in MOM software
=> Tomcat is not providing any MOM software..so if u r application is using tomcat server then prefere working with Active MQ as the MOM software.

=> JMS supports both PTP and pub-sub Models of Messaging
=> The MiddleMan software between send and reciver/consumer who takes messages given by sender and holds them for Reciver to come and cosume is called MOM
=> MOM contains destinations as the logical mememories to recived and hold the messages..
In PTP model this destination is called "Queue" and in pub-sub model this destination is called "Topic"





=> JMS provides api representing rules and guidelines in the form of interfaces,classes placed in javax.jms or jakarta.jms and its subpkgs. (It is like JDBC API)

=> Active MQ, weblogic MQ, WildlfyMQ and etc.. are MOM softwares which are internally providing impl classes for JMS API intefaces (These are like JDBC DRIVERS)

=>Programmers takes impl classes through JMS interrfaces .. to create objects and to consume services [The Sender and reciver Apps will be developed using JMS Api referring one or another MOM Impl sofwares) (These are like Java Apps using JDBC drivers through JDBC API)

feb 02.1 Messaging using JMS

sample reference code to understand API , Impl software and App development using API

```
interface Operation1{
  public void process();
}
interface Operation2{
  public String process(String msg);
}
```

It is like JMS API given by Sun Ms (JMS specification)

```
public class Operation1Impl implements Operation1{
  public void Process(){
    ....
  }
}
public class Operation2Impl implements Operation2{
  public String Process(Stirng msg){
    ....
  }
}
```

=> impl classes provided by the Vendor

(It is like active Mq , weblogic mq and etc.. MOM softwares give by different Vendors

```
Operation1 op1=new Operation1Impl();
op1.process();
Operation1 op2=new Operation2Impl();
String result= op2.process("hello");
```

It Like JMS application devleoped the Programmer

=>The interface that contains only one abstract method direclty or indirectly is called functional Interface.

```
@FunctionalInterface
interface Operation1{
  public void process(String msg);
}
```

Functional interface

Impl1 ::

```
public class Operation1Impl implements Operation1{
  public void proess(String msg){
    ...
    ..
  }
}
```

Normal Impl class

Impl2 :: Anyonomous inner class (inline impl)

```
Operation1 op1= new Operation1(){
  public void process(Stirng msg){
    ...
    ...
  }
};
```

Here Anonymous inner class is created implementing Operation1 interface and process(-) is implemented in that class.

Impl3 :: Lamda based anonymous inner class (anonymous inner clss Impl class obj + method impl) (InLine impl)

```
Operation op1= (msg)->{ ....
                      }
```

spring

The JMS api is providing one Funcational Interface called "MessageCreator" as shown below

```
@FunctionalInterface
public interface MessageCreator {
    Message createMessage(Session session);
}
```

Impl1 (Using anynomous innner class)

```
MessageCreator mc=new MessageCreator(){
    public Message createMessage(Sesssion ses){
      .... // logic
      ....
      return message obj;
    }
}
```

Impl2 (Using Lamda anonymous inner class)

```
MessageCreator mc=(ses)->{ .....
                           ...
                           return message obj;
                         }
```

(or)

```
MessageCreator mc=ses-> message obj;
```

SpringBoot JMS/spring JMS provides abstraction on plain JMS to simplify the messages based communication with the support of "JMSTemplate" (template method DP)

Procedure to keep ActiveMq as MOM software

step1) Dowload ActiveMQ software as zip file from Internet

https://activemq.apache.org/components/classic/download/

ActiveMQ 5.16.3 (Aug 17th, 2021)

Release Notes | Release Page | Documentation

Windows	apache-activemq-5.16.3-bin.zip	SHA512	GPG Signature
Unix/Linux/Cygwin	apache-activemq-5.16.3-bin.tar.gz	SHA512	GPG Signature
Source Code Distribution:	activemq-parent-5.16.3-source-release.zip	SHA512	GPG Signature

step2) Extract the zip file to a folder.

step3) start the ActiveMQ software

E:\ActiveMQSoft\apache-activemq-5.16.3\bin\win64\activemq.bat file

step4) open admin console page of Active MQ software

http://localhost:8161

username : admin
password : admin

step5) Observer Topic and Queue sections in admin console page

home page ---> manage active mq --->

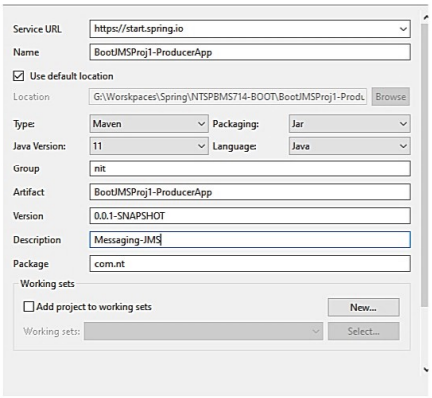
feb 03 Messaging using JMS (PTP Example)

Procedure to develop JMS PTP (Queue) application using active MQ

=>In any JMS App (Producer /Sender or Reciver /Subscriber/consumer) once we spring -boot-starter-activemq starter as dependency we get JMSTemplate class object through AutoConfiguration that can be injected to Sender / Reciver App through Autowiring.

For Producer App

step1) create spring boot project adding active mq starter..




```
<dependency>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-starter-activemq</artifactId>
    </dependency>
```

step2) add the following properties in application.properties file

```
# MOM connectivity Details
spring.activemq.broker-url=tcp://localhost:61616
spring.activemq.user=admin
spring.activemq.password=admin

#enable PTP communication
# true enables pub-sub model and false enables ptp model
spring.jms.pub-sub-domain=false
```

#8161 for admin console
61616 for actual MOM service

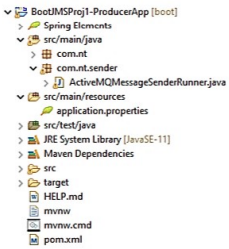
step3) Develop runner class as the Message sender

=>JmsTemplate class is having send(-,-) method taking destiona (queue/topic) logical name(generally new name) and MessageCreator(I) (Functional interface).

```
public void send(Destination destination,   MessageCreator messageCreator)   throws JmsException
```

For this we can pass either anonymous inner class obj or Lamda style inner class obj

Runner class having sender logic




```
package com.nt.sender;

import java.util.Date;

import javax.jms.JMSException;
import javax.jms.Message;
import javax.jms.Session;

import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.boot.CommandLineRunner;
import org.springframework.jms.core.JmsTemplate;
import org.springframework.jms.core.MessageCreator;
import org.springframework.stereotype.Component;

@Component
public class ActiveMQMessageSenderRunner implements CommandLineRunner {
    @Autowired
    private JmsTemplate template;

    @Override
    public void run(String... args) throws Exception {
  /*      //using anonymous inner class logics
        template.send("testmq1", new MessageCreator() {
            @Override
            public Message createMessage(Session ses) throws JMSException {
                Message message=ses.createTextMessage("From Sender at ::"+new Date());
                return message;
            }
        }); */

        /* using LAMDA style anonyomous inner class
         template.send("testmq1",ses->{
            return ses.createTextMessage("From sender at"+new Date());
        });*/

            //using LAMDA style anonyomous inner class
            template.send("testmq1",ses-> ses.createTextMessage("From sender at"+new Date()));
            System.out.println("Message sent");
    }//run
}//class
```

step4) Make sure that Active MQ started

E:\ActiveMQSoft\apache-activemq-5.16.3\bin\win64\activemq.bat

step5) Run the Sender App and ActiveMQ Server console

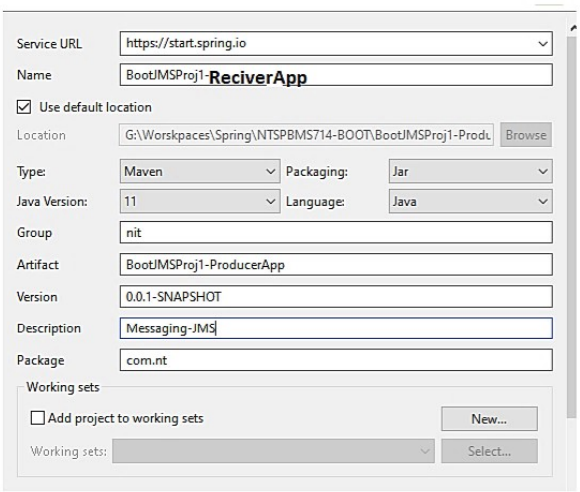
Queues:

Name	Number Of Pending Messages	Number Of Consumers	Messages Enqueued	Messages Dequeued	Views	Operations
testmq1	1	0	2	1	Browse Active Consumers Active Producers atom rss	Send To Purge Delete Pause

feb 03.1 Messaging Using JMS (PTP Example)

Procecedure to develop Consumer/Reciever App of PTP model using ActiveMQ MOM software

step1) create spring boot project adding active mq starter..

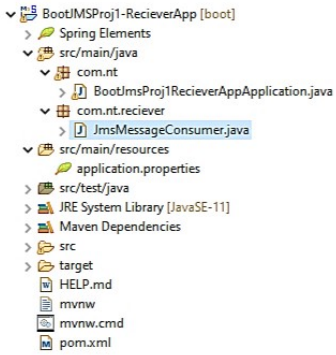



```
<dependency>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-starter-activemq</artifactId>
    </dependency>
```

step2) add the following properties in application.properties file

```
# MOM connectivity Details      #8161 for admin console , 61616 for actual MOM service
spring.activemq.broker-url=tcp://localhost:61616
spring.activemq.user=admin
spring.activemq.password=admin

#enable PTP communication
# true enables pub-sub model and false enables ptp model
spring.jms.pub-sub-domain=false
```

step3) Develope the java class having @JMsListener method as shown below.




```
package com.nt.reciever;

import org.springframework.jms.annotation.JmsListener;
import org.springframework.stereotype.Component;

@Component
public class JmsMessageConsumer {

    @JmsListener(destination = "testmq1")
    public   void  readMessage(String text) {
            System.out.println("Recived Message::"+text);
    }

}
```

These messages executes automactically to read message from queue destination

step4) Run the App Consumer App

(reads the message from Quue destinaiuon)

step5) Observe the console

Queues:

Name	Number Of Pending Messages	Number Of Consumers	Messages Enqueued	Messages Dequeued	Views
testmq1	0	0	2	2	Browse Active Consumers Active Producers atom rss

Keypoints on PTP model messaging

(a) The destination name is "Queue". (FIFO rule)

(b) Both Sender and reciver need not be active at a time

(c) One Message will have only one Reciever/Consumer

(d) The Queue Destination can send message to reciever App who connected to the Destination before Sender sends the message will also the recieve the message when the sender sends the messsage.

(e) if multiple consumer are waiting for a message sent by the SEnder then only first reciver the recieves the message.

(f) The queue destination delivers the message to Reciever App and deletes the message.

usecase:: our car factory usecase needs this model (PTP) communication

feb 04 Messaging using JMS (PUB SUB Example)

How to make Sender of App PTP Model sending message continuosly to MOM software

=> we can take the support of scheduling concept.. For that we need to add @Scheduling annotation on the b.method of Sender App.

note:: @Scheduling can not be applied on the method with args.. So make sure that u r b.method is designed having no args/params.

```
@Component
public class ActiveMQMessageSender    {
@Autowired
private JmsTemplate template;

@Scheduled(cron="*/10 * * * * *")
public void sendMessage() {
//using LAMDA style anonyomous inner class
 template.send("testmq1",ses-> ses.createTextMessage("From sender at"+new Date()));
 System.out.println("Message sent");
 }//run
}//class
```

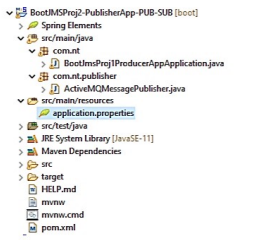
note:: while developing sender and Reciver Apps .. placing @EnableJms on the top of main class is optional.

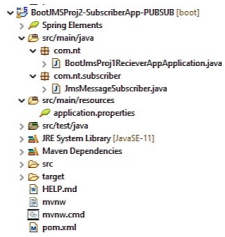
Developing ActiveMQ Pub-sub model App

=>All are same in both Sender/Publisher App and also in Reciever/Subscriber App but change

in application.properties

```
spring.jms.pub-sub-domain=true
```





Order of execution

=>Run subscriber App for multiple times (more than 1 time) (To give the feel more subscribers)
=>Run publisher App
=> Check the console windows of subscribers application

(web console screen /page of active MQ)

Keypoints on pub sub model

(a) One message published by publisher can be consumed by more than one subscriber
(b) The subscribers must done their subscription before publisher publishes the message
(c) The message published by publisher will be duplicated and will be delivered to multuiple subscribers
(d) The Publisher and Subscribers all must be in active mode at a time.
(e) In this model the Destination name is Topic.
(f) Once the subscriber consums the message the message from Topic destination of MOM s/w will not be deleted.

Can we send java object data over the network ?

a) yes , by making the object as Serializable object.

note: Serializing object means the converting object data into stream of bits -bytes that are required to send data over the network or to write to destination file.

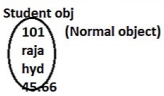
How does normal object become Serilizable object?

=> By making the class of the object as the Serializable class .. (class must implement java.io.Serializable(I))

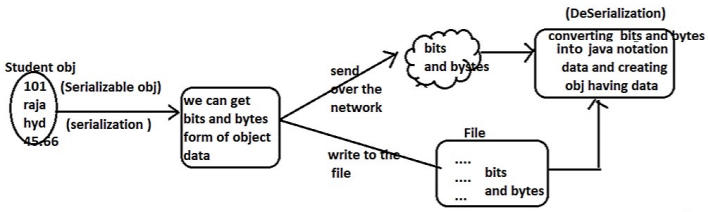
java.io.Serializable(I) is empty interface (marker interface) then how does it makes its impl class object as the Serializable object?

Ans) Markers Interface does nothing directly .. By seeing the marker interface implementation the underlying JVM /Server /Framework /Container provides special runtime capabilities to implementation class objs they create.

=> if JVM is create object for normal class .. that object data is in java format and can not be converted to stream of bits and bytes i.e we can not send/write normal object over the network or to a file.



=> if JVM is creating object for Serializable class (class implementing java.io.Serializable(I)) then the JVM provides capability to the object to convert its data as stream of bits and bytes when needed to send the object's data over the network or to write to a file.



=>Most of marker interfaces are empty interface.. but we can not say every empty interface is marker interface.
=> We can develop our own custom marker interface .. but we need to create custom Container to provider runtime capabilities to the impl class objs of custom marker interface.

other marker interfaces are
=========================
java.io.Serializable(I)
java.lang.Cloneable(I)
java.rmi.Remote(I)
Repository(I) of spring data jpa
java.lang.Runnable (not empty)
and etc..

To decide wheather interface is marker or not ...
do not take emptiness as the criteria.. Take wheather the underlying JVM/container/server/Framework/... providing special runtime capabilities to the impl class object or not.

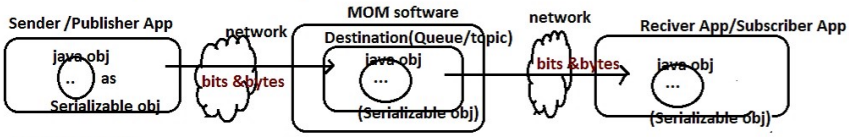
feb 05 Messaging using JMS for sendign Object as Message

==========

Developing ActiveMq PTP application to send Object as message

==========

=> since Sender and Reciever Apps can be there in two different machines of a network or there is possibility of running MOM software on different machine so we need to take the object as Serializable object ..



Sender App code

==========

step1) create spring boot project adding activemq , lombok dependencies

step2) Develop the Java bean class as the Model class.

```
//Model class
============
package com.nt.model;
import java.io.Serializable;
import lombok.AllArgsConstructor;
import lombok.Data;
import lombok.NoArgsConstructor;

@Data
@NoArgsConstructor
@AllArgsConstructor
public class ActorInfo implements Serializable {
        private  Integer actorId;
        private String actorName;
        private String actorAddrs;

}
```

step3) Develop the Sender App by Enabling Scheduling

```
//Sender class
----------------------

package com.nt.sender;

import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.jms.core.JmsTemplate;
import org.springframework.scheduling.annotation.Scheduled;
import org.springframework.stereotype.Component;

import com.nt.model.ActorInfo;

@Component
public class ObjectMessageSender {
    @Autowired
    private JmsTemplate template;

    @Scheduled(cron = "0/20 * * * * *")
    public  void  sendObjectDataAsMessage() {
        //prepare object
         ActorInfo actor=new ActorInfo(1001, "ranveer", "mumbai");
        //send object as the message
         template.convertAndSend("obj_mq1", actor);
         System.out.println("Object is send  as Message ");
    }

}
```

The SimpleMEssageConvertor class contains logic to convert given Serializable object into JMS style Message object.

main class

```
----------
 @SpringBootApplication
 @EnableScheduling
 @EnableJms
 public class BootJmsProj3SendingObjectSenderAppApplication {

      public static void main(String[] args) {
           SpringApplication.run(BootJmsProj3SendingObjectSenderAppApplication.class, args);
      }
 }
```

step4) Add properties in application.properties file

```
 MOM connectivity Details
spring.activemq.broker-url=tcp://localhost:61616
spring.activemq.user=admin
spring.activemq.password=admin

#enable  PTP  communication
# true enables  pub-sub model and false enables  ptp model
spring.jms.pub-sub-domain=false

# make  all packages as the trusted packages (especically model class pkg)
# to send/recieve model class object data as message to MOM software
spring.activemq.packages.trust-all=true
 # or
#spring.activemq.packages.trusted=com.nt.model
```

if we do not place this entry them there is a possibility of getting the following error

This class is not trusted to be serialized as ObjectMessage payload. Please take a look at activemq.apache.org/objectmessage.html for more information on how to configure trusted classes.

step5) Makesure Activem MQ software (MOM software) is in running mode

use E:\ActiveMQSoft\apache-activemq-5.16.3\bin\win64\activemq.bat file

step6) Run the Send App ...

feb 05.1 Messaging using JMS for sendign Object as Message

Reciver App Code

==========

step1) create spring boot project adding activemq , lombok dependencies

step2) Develop the Java bean class as the Model class.

(copy from sender App)

```
//Model class
============
package com.nt.model;
import java.io.Serializable;
import lombok.AllArgsConstructor;
import lombok.Data;
import lombok.NoArgsConstructor;
@Data
@NoArgsConstructor
@AllArgsConstructor
public class ActorInfo implements Serializable {
        private Integer actorId;
        private String actorName;
        private String actorAddrs;
}
```

step3) Add properties in application.properties file

```
MOM connectivity Details
spring.activemq.broker-url=tcp://localhost:61616
spring.activemq.user=admin
spring.activemq.password=admin

#enable PTP communication
# true enables pub-sub model and false enables ptp model
spring.jms.pub-sub-domain=false

# make all packages as the trusted packages (especically model class pkg)
# to send/recieve model class object data as message to MOM software
spring.activemq.packages.trust-all=true
 # or
#spring.activemq.packages.trusted=com.nt.model
```

step4) Deveop the ReciverApp as JMSListener...

```
package com.nt.reciever;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.jms.annotation.JmsListener;
import org.springframework.jms.core.JmsTemplate;
import org.springframework.scheduling.annotation.Scheduled;
import org.springframework.stereotype.Component;
import com.nt.model.ActorInfo;
@Component
public class ObjectMessageReciever {
        @JmsListener(destination = "obj_mq1")
        public void consumeObjectDataAsMessage(ActorInfo actor) {
                System.out.println("Recived Object Data ::"+actor);
        }
}
```

step5) Run the Reciver App ...

Limitation of JMS

---

a) JMS is java language dependent technology i.e we need to develop both sender and reciver App in same java language .. (JMS can not be used outside of Java Domain)

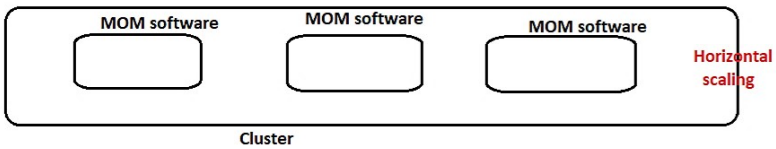
b) JMS based MOM softwares can recieve and send messages only by using protocol TCP i.e we can not use other than protocol TCP like http , smtp and etc..

c) There is a possibilty of loosing data /message if the MOM software is down or MOM software is not responding while publisher or sender is sending the messages

d) if the Message is very big / large scale then MOM software behaves very slow (i.e gives the performance issue)

e) There is no ability of creating multiple instances of single MOM software .. if multiple senders /publishers are sending messages simultaenously the Performance of single copy MOM software may not suitable for industry needs.

(It indirectly say JMS style MOM software does not horizontal scaling.. it supports only vertical scaling)



Conclusion:: use JMS style messaging only when no.of message are less and no.of senders/publishers are less towards sending messages.

feb 06 Apache kafka Installation & working with Flow

Apache Kafka
==========

=> It is java based messaging technique .. which can be implemented in different languges

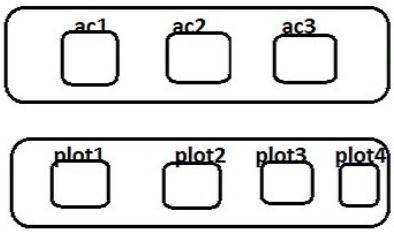
=> It supports to use different technologies and concepts for messaging activity like hadoop, spark, scala and etc..

(kafka integration is possible with multiple technologies of java and non-java env..)

=> Apache kafka is all about Store + Process + Integrate (Transfer)

=>Kafka is basically used to transfer (integrate) data /messsages between multiple complex Apps/systems using Cluster design.

cluster :: set of similar items is called cluster.



Ex:-like connection pool

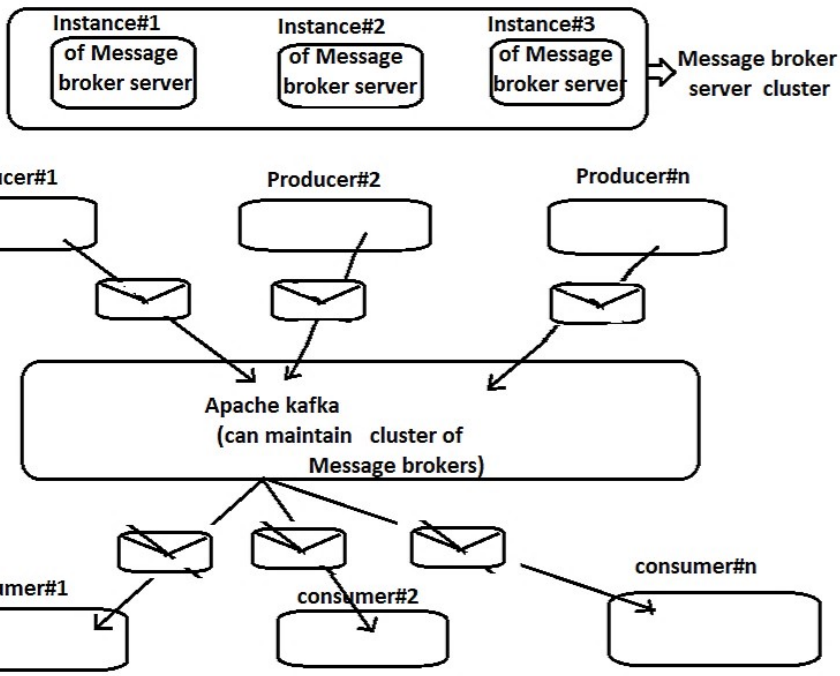
=>Kafka intergration /interaction with non-java applications is possible with the support of REST calls.

=> Karfka is protocol Independent ... we can write code to send messages among the applications using http ,tcp ,ftp and etc .. protocols.

=> Kafka allows to take multiple message broker s/ws (MOM s/ws) at a time as cluster having support for Horizontal scaling giving the following advantages..

a) Fast data transfer for larget data set /messagess
b) No data loss even one messsage broker s/w or MOM s/w is down becoz other broker s/w or MOM s/w takes care of messages.
c) It takes the support of apache zookeeper to handle load balancing among the multiple instances of message broker s/w or MOM s/w

apache zookeepr is like netflix eureka server..



-

feb 06.1 kafka Intro

Kafka Message Broker / Broker server / Mom Server (MOM server is not official word)

==========

It behaves like MOM/Broker to recieve messages/data from sender, to hold them as needed and to deliver to Consumer ..

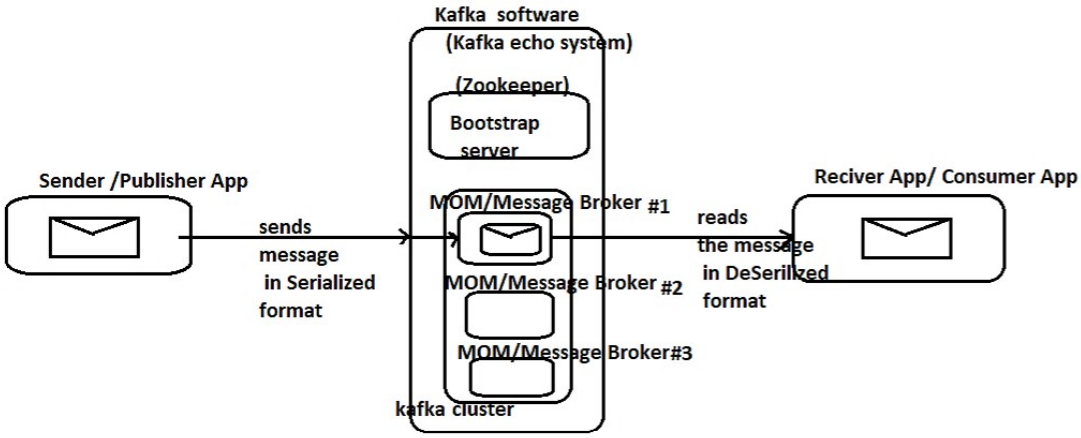
=>When kakfa s/w is started one instance of Message broker will be created automatically.. and it can be increased as needed.

=> collection message broker instances togather is called kafka message broker cluster .. and we can add any no.of instances in one cluster .. i.e there is no limit to add instances.

=>Apache Zookeepr is resposible to manage message broker instances of cluster by applying Load Balance support and it is also called Bootstrap server becoz it is responsbile to create cluster having single instance and increasing the instances as needed.

=>Apache kafka Eco System = (Zookeeper) Boostrap server + message broker cluster.

=> The apache kafka Message broker gets Message from Sender /Publisher App in Serialized format and delivers to consumer /subscriber in DeSerialized format.



=> kafka do not support PTP model messaging i.e the message broker/MOM can not have Queue as the Destination

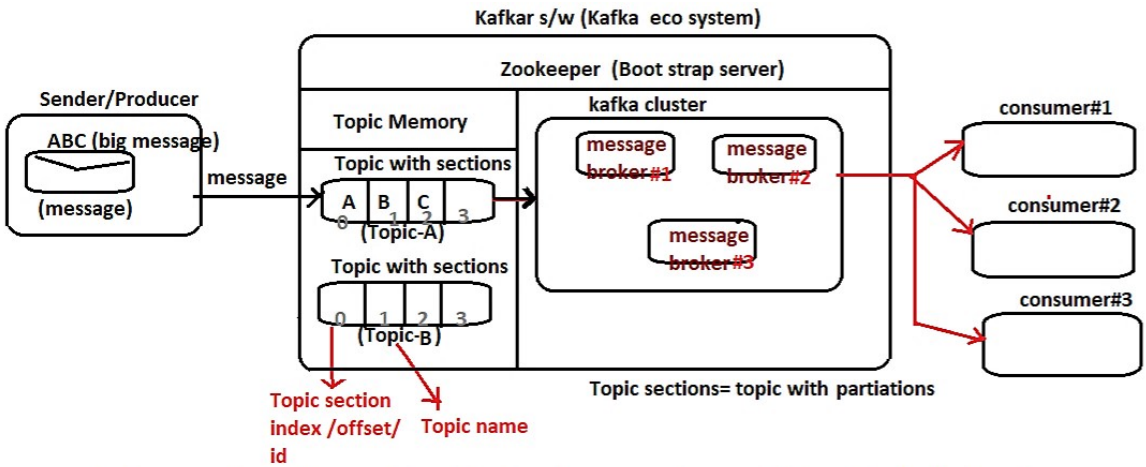
=> kafka supports only Pubsub mode messaging i.e the message broker /MOM can have only Topic as the destination.

=> To send message only to one consumer .. we take the support of topic Destination.

=>For one message one topic destination (Memory) is created/allocated ..that stores given data /message in partiations (huge messsage will be divied into parts/packets). Every paritiation of the message is indentified with an index like 0,1 ,2,3 .. These indexes are technically called as offsets.

=> In kafka messaging , For one consimer one message broker instance will be allocated at a time.
So to send 1 message to 5 consumers we need
1 Sender ---> 1 message --> 1 Topic with sections/partiations --> 5 message broker instanaces -- 5 cosumers

=> At a time , the Message broker reads one paritiation data , takes the data , replicates data (cloned data) and sends to consumer i.e each large message/data will be stored in multiple partiations of topic and the messge broker reads data from all partiations and sends to its respective consumer.



=>Each message broker instance is capable of reading message from multiple sections/partiations of Topic destinations... replicates the message parts -- merges the message parts --sends the message to respective consumer.

feb 06.2 kafka intro

Apache Kafka terminologies

Message Broker /MOM :: The mediator /Middle man that will transfer message to consumer by reading message/data from Topic /Topic partiotions

kafka cluster :: collection /group of message broker instances which are created based cosumers count is called kafka cluster.

Topic :: The memory that holds message sent by the Producer in parts

Producer :: The App/comp that sends the message to Topic Memory in Serialized format

Consumer :: The App/comp that reads the message from Topic Memory through Message Broker in DeSerialized format

offset/index :: The id or index given to partiation message/data in Topic

Zookeeper /BootstapServer :: Handles Message Broker Cluster and Topic Memory .. While managing the Message broker cluster it will do Load Balancing.

Replica-Factor :: The no.of cloned/duplicate messages that should be created in order to send the messages to Consumers through message brokers ..

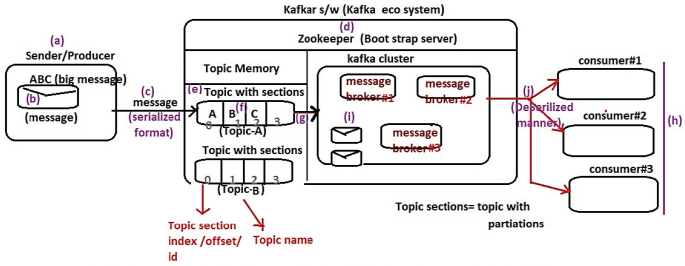
Generally it is decided based consumer count.

=>if there are 10 cosumers then Replica-factor is 1/10 (For 1 message 10 clonnded copies are required)

==========

Apache kafka Work Flow Diagram

==========



=>Each message broker instance is capable of reading message from multiple sections/partiations of Topic destinations... replicates the message parts -- merges the message parts --sends the message to respective consumer.

(a) Define one Producer App

(b) Create either Static message or dynamic message that can be given at runtime

(c) Send message from Producer in the form fo key=value pair format

here "key" is topic name (With the given name topic available then uses it other wise new topic will be created)

"value" is the message/Data

note:: Producer App sends this data/message in Serilized format.

(d) Start zoo keeper (Boot starp server)

(e) Topic Section will be created in Topic Memory to read the message sent by the producer App..

note: New Topic section will be created (if not already available) otherwise it will use the existing Topicsection

(f) Topic section reads message and stores message in different partiations of Topic which will be created as needed.

(note:: These partiations are identified with indexes /offsets)

(g) creates link b/w Topic section/Topic and Message broker

(h) Define one or more consumer Apps as needed by specifying topic name

(note:: Based on the given Topic name in cosumer App(s) the link b/w Topic , message broker and Cosumer App will be created as needed)

(note:: The zookeeper takes the responsbility of creating messagebroker instances as cluster based on the Consumer count and takes care of LB -Load Balancing)

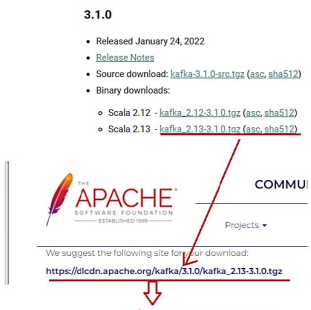
(i) The Message Broker(s) reads the data/messages from Topic Partiations creates cloned/replicate copies of these partitaion messages.

j) The message broker(s) sends the cloned partiation messages to one or more consumer(s) part by part.

Arranging Apache Kafka Software

==========

Go to https://kafka.apache.org/downloads



gives kafka_2.13-3.1.0.tgz

==> Copy this file (E: drive) and extract it

Sending Message using apache kafka infrastructure

==========

step1) start Zookeeper as Boot strap server..

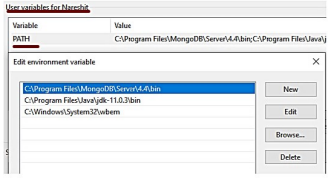
```
E:\kafka_2.13-3.1.0\bin\windows>zookeeper-server-start E:\kafka_2.13-3.1.0\config\zookeeper.properties
```

command as .bat file (input value)

step2) start apache kakfa s/w setup

i) make sure that "C:\Windows\System32\wbem" is added PATH env.. variable (User Variable)

Mycomputer ---> proeprties ----> advanced system settings --->



env.. variables ---> user vairables

-> new --->

variable name :: PATH

value :: C:\Windows\System32\wbem

ok --->ok --->ok

ii) E:\kafka_2.13-3.1.0\bin\windows>kafka-server-start E:\kafka_2.13-3.1.0\config\server.properties

step3) Create new topic specifying reflection factor (no.of copies) , partintiations count (offset count)

```
E:\kafka_2.13-3.1.0\bin\windows>kafka-topics --create --bootstrap-server localhost: 9092
                --replication-factor 1 --partitions 1 --topic nit-tpc
```

step4) Create a producer and link with message broker with support of bootstrap-server

```
E:\kafka_2.13-3.1.0\bin\windows>kafka-console-producer --bootstrap-server localhost:9092 --topic nit-tpc hello
>hai
>123
```

send these messages after starting the consumer

messages

step5) create a consumer and link with message broker

```
E:\kafka_2.13-3.1.0\bin\windows>kafka-console-consumer.bat --bootstrap-server
                localhost:9092 --topic nit-tpc
hello
hai
123
```

feb 09 developing Kafka Clients Using Java APIs

Developing Kafka Client Apps using Java API

=> Both Producer /Sender and reciver/Consumer Apps that are talking to kafka software are called kafka Client Apps.

Producer /Sender App Development (Legacy Style - spring style)

=> First we need to establish a link between Producer App and kafkat setup (mainly bookstrap server) by using the following details /properties

#1 bootstrap-server = localhost:9092 (Kafka Bootstarp server default port is 9092)
key-serializer = pkg.StrngSerializer we generally keep this info in Properties class obj
value-serializer = pkg.StringDeSerializer we develope app in legacy style (not spring boot style)

note1:: any type of data /message given by Producer will be converted to String message/data using StringSerializer class that is specified above. if we give java object as message/ data then it will be converted into json String content .

=> Take the support of "ProducerRecord" class to sepcify Message object details and topic name

#2 ProduderRecord<String,String> record=new ProducerRecord("topicname", message object);

(ProducerRecord class obj indirectly represeing message/data to send from producer App to topic of kafks setup)

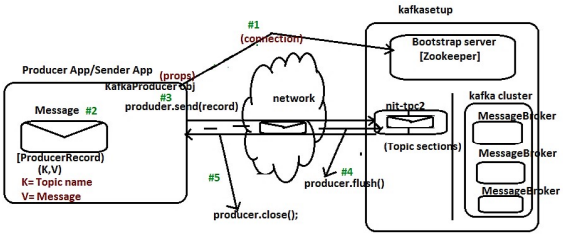
=> To send Message (ProducerRecord) created in the Producer App we need to use KafkaProducer<String,String> class as shown below

#3 KafkaProducer<String,String> producer=new KafkaProducer<>(props);

producer.send(record); //puts data in connection stream in queue

#4 producer.flush(); //sends to data Topic based on the given topic name

#5 producer.close(); // Closes the link b/w producer and kafks setup (Bootstarp server)

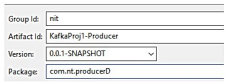


Code development and execution

step1) create maven project (not sprng boot starter Project) using maven-archetype-quickstart

adding the following dependencies (kafkaclients , slf4j-simple , jackson-dataformat-xml)

File menu ---> maven project ---> next --->
select maven-archetype-quickstart --->next -->



In pom.xml

```
<!-- https://mvnrepository.com/artifact/org.apache.kafka/kafka-clients -->
<dependency>
    <groupId>org.apache.kafka</groupId>
    <artifactId>kafka-clients</artifactId>
    <version>3.1.0</version>
</dependency>

<!-- https://mvnrepository.com/artifact/org.slf4j/slf4j-simple -->
<dependency>
    <groupId>org.slf4j</groupId>
    <artifactId>slf4j-simple</artifactId>
    <version>1.7.35</version>
    <scope>test</scope>
</dependency>

<!-- https://mvnrepository.com/artifact/com.fasterxml.jackson.dataformat/jackson-dataformat-xml -->
<dependency>
    <groupId>com.fasterxml.jackson.dataformat</groupId>
    <artifactId>jackson-dataformat-xml</artifactId>
    <version>2.13.1</version>
</dependency>
```

step2) Develop the Producer App

```
package com.nt.producer;
import java.util.Properties;
import org.apache.kafka.clients.producer.KafkaProducer;
import org.apache.kafka.clients.producer.ProducerConfig;
import org.apache.kafka.clients.producer.ProducerRecord;
import org.apache.kafka.common.serialization.StringSerializer;
public class MEssageProducer {

    public static void main(String[] args) {
        // create Connection properties as K=V in java.util.Properties class obj
        Properties props=new Properties();
        props.put(ProducerConfig.BOOTSTRAP_SERVERS_CONFIG, "localhost:9092");
        props.put(ProducerConfig.KEY_SERIALIZER_CLASS_CONFIG,StringSerializer.class.getName());
        props.put(ProducerConfig.VALUE_SERIALIZER_CLASS_CONFIG,StringSerializer.class.getName());
        //create KafkaProducer object
        KafkaProducer<String, String> producer=new KafkaProducer<String, String>(props);
        //create ProducerRecord object representing the message
        String msg="WELcome to Apache kafkas messaging";
        String topicName="nit-tpc-feb";
        ProducerRecord<String, String> record=new ProducerRecord<String, String>(topicName, msg);
        // Send message (record)
        producer.send(record);
        //flush the message
        producer.flush();
        //close the connection with BootStrap server
        producer.close();
        System.out.println("message sent");
    }
}
```

step3) Execute things in the following order

a) start zookeeper b) start kafka setup c) create topic d) Run the above Producer App
e)start Consumer (readmade)

a)start zookeeper

```
E:\kafka_2.13-3.1.0\bin\windows>zookeeper-server-start.bat E:\kafka_2.13-3.1.0\config\zookeeper.properties
```

b) start kafka setup

```
E:\kafka_2.13-3.1.0\bin\windows>kafka-server-start.bat E:\kafka_2.13-3.1.0\config\server.properties
```

c) create Topic and topic sections

```
E:\kafka_2.13-3.1.0\bin\windows>kafka-topics --create --bootstrap-server localhost:9092
                                --topic nit-tpc-feb --replication-factor 1 --partitions 1
Created topic nit-tpc-feb.
```

d) start the consumer App

```
E:\kafka_2.13-3.1.0\bin\windows>kafka-console-consumer --bootstrap-server localhost:9092 --topic nit-tpc-feb
```

WELcome to Apache kafkas messaging

e) run producer App from eclise ide sends message

feb 10 Developing Kafka Clients using Java APIs

Developing kafka consumer as kafka client in legacy style (spring style)

==========

#1] We need to create communication link b/w kafka setup and consumer(s) by supplying multiple details connection details as key=value pairs in the form of Properties object

bootstrap-server = localhost:9092
key-deserializer = StringDeSerializer
value-deserilizer = StringDeSerializer
(given by kafka api)
groupid = grp-listeners [anything can be given here] [optional]

=> if multiple consumers are taken reading same message from topic thorugh message broker then grouping multiple consumers to single group by providing groupid make replicate /cloning operation on messages faster.

#2] create KafkaConsumer class object specifying the above connection properties to get link /connection between consumer and kafka setup (Indirectly with Bootstarp server (zookeeper) that manages Topic memories and message brokers.

```
KafkaConsumer<String,String> consumer=new KakfaConsumer<>(props);
```

java.util.Properties class obj having the above connection properties

#3] Link Consumer with MessageBroker by specifying the topic name
[Here MessageBroker will be created dynamically on 1 per Consumer basis)

```
consumer.subscribe(Arrays.asList("nit-tpc-feb"));   // we given multiple topic names
                                                    // to read messages from muliple topic sections
```

#4] Do polling (pinging the message broker continuosly having certain gap) wth Message broker to check message(s) avaiable or not and read message. (indirectly every second tracking)

Expected process ::

On arrival of message to topic memory , the Message broker reads the messages and sends the message to all the subscribed consumers automatically .. but In legacy style kafka consumer devleopment that is not happening . So polling has to be done

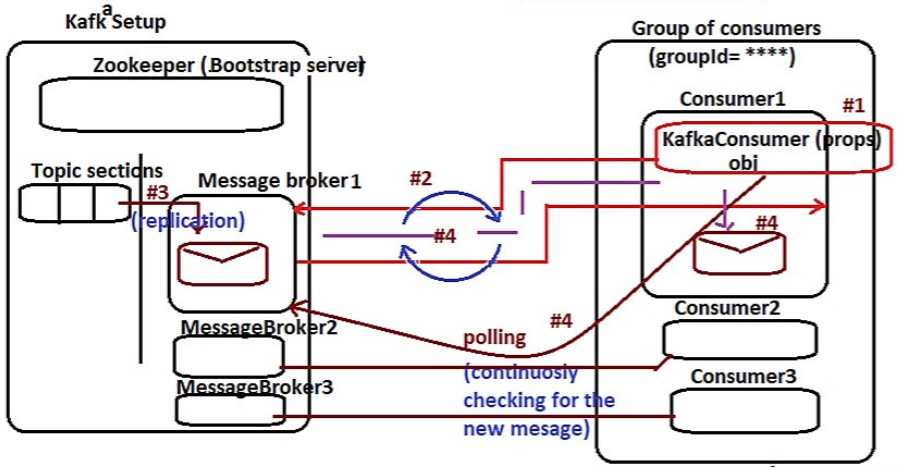
Actual process

==========

=> Consumer pings the Message Broker having scheduling (having certain continuos time gap) for new message .. if came to topic memory then the message broker gives that message to consumer (this process is polling)

```
while(true){
   ConsumerRecords<String,Stirng> records=
                    consumer.poll(Duration.ofMillis(1000));

    for(ConsumerRecord<String,String> record: records){
        System.out.println("message is ::"+record.value());
    }//for
  } //while
```

=>Each consumed message will be represented by ConsumerRecord object
Multiple comsumed messages will be represented by ConsumerRecords object.



=> Each messsage comes as the Consumer Record obj

feb 10.1 Developing Kafka Clients using Java APIs

Code (Kafka Consumer Code)

==========

step1) create maven project adding the following dependencies

kafka clients , slf4j-simple , jacson-data format-xml (same producer App)

```
<!-- https://mvnrepository.com/artifact/org.apache.kafka/kafka-clients -->
<dependency>
  <groupId>org.apache.kafka</groupId>
  <artifactId>kafka-clients</artifactId>
  <version>3.1.0</version>
</dependency>

<!-- https://mvnrepository.com/artifact/org.slf4j/slf4j-simple -->
<dependency>
  <groupId>org.slf4j</groupId>
  <artifactId>slf4j-simple</artifactId>
  <version>1.7.35</version>
  <scope>test</scope>
</dependency>

<!-- https://mvnrepository.com/artifact/com.fasterxml.jackson.dataformat/jackson-dataformat-xml -->
<dependency>
  <groupId>com.fasterxml.jackson.dataformat</groupId>
  <artifactId>jackson-dataformat-xml</artifactId>
  <version>2.13.1</version>
</dependency>
```

step2) Develop the Consumer App

MessageConsumer.java

```
package com.nt.consumer;

import java.time.Duration;
import java.util.Arrays;
import java.util.Properties;

import org.apache.kafka.clients.consumer.ConsumerConfig;
import org.apache.kafka.clients.consumer.ConsumerRecord;
import org.apache.kafka.clients.consumer.ConsumerRecords;
import org.apache.kafka.clients.consumer.KafkaConsumer;
import org.apache.kafka.common.serialization.StringDeserializer;

public class MessageConsumer {

 public static void main(String[] args) {
 // create Connection properties as K=V in java.util.Properties class obj
 Properties props=new Properties();
 props.put(ConsumerConfig.BOOTSTRAP_SERVERS_CONFIG, "localhost:9092");
 props.put(ConsumerConfig.KEY_DESERIALIZER_CLASS_CONFIG,StringDeserializer.class.getName());
 props.put(ConsumerConfig.VALUE_DESERIALIZER_CLASS_CONFIG,StringDeserializer.class.getName());
 props.put(ConsumerConfig.GROUP_ID_CONFIG,"grp1_consumers");
 //create KafkaConsumer object
 KafkaConsumer<String, String> consumer=new KafkaConsumer<String, String>(props);
 //Subscribe to topic Destination through MEssagebroker
   consumer.subscribe(Arrays.asList("nit-tpc-feb"));
  //Performing polling to check and read the messages
   while(true) {
        //poll and get consumer records (messages)
       ConsumerRecords<String,String> records=consumer.poll(Duration.ofMillis(2000));
        // read and display messages
          for(ConsumerRecord<String,String> record:records) {
                System.out.println("message is ::"+record.value());
          }//for
    }//while
    }
    }
```

step3) **Run The services in the following order**

a) start zookeeper as boostrap server

```
E:\kafka_2.13-3.1.0\bin\windows>zookeeper-server-start.bat
                                        E:\kafka_2.13-3.1.0\config\zookeeper.properties
```

b) start apache kafka setup

```
E:\kafka_2.13-3.1.0\bin\windows>kafka-server-start.bat
                                        E:\kafka_2.13-3.1.0\config\server.properties
```

c) note:: since Topic name "nit-tpc-feb" is already created.. So we need not to create again

d) Run the consumer App using eclipse

e) Run the Producer App using eclipse (previous class App)

feb 12 Developing Kafka Clients using spring boot kafka apis

Spring Boot + Apache Kafka API
==========

=> Spring Boot gives built-in support for apache kafka.. It even given certain objects automatically through AutoConfiguration process

=> if spring -boot- starter-apache-kafka depenecies to app then we get KafkaTemplate<K,V> class object through autoConfiguration..
which internally takes care of creating KafkaProducer, ProducerRecord objects that are required to send messages/data.

In Producer class or comp

```
@Autowired
private KafkaTemplate<String,String> template;
```

=> we can place @KafkaListener(topicName="....." , groupId=".....") annotation on the method Listener class to make Message broker to collect the message recived to topic section i.e it internally takes care of creating KafkaConsumer<String,String> obj and ConsumerRecord object.

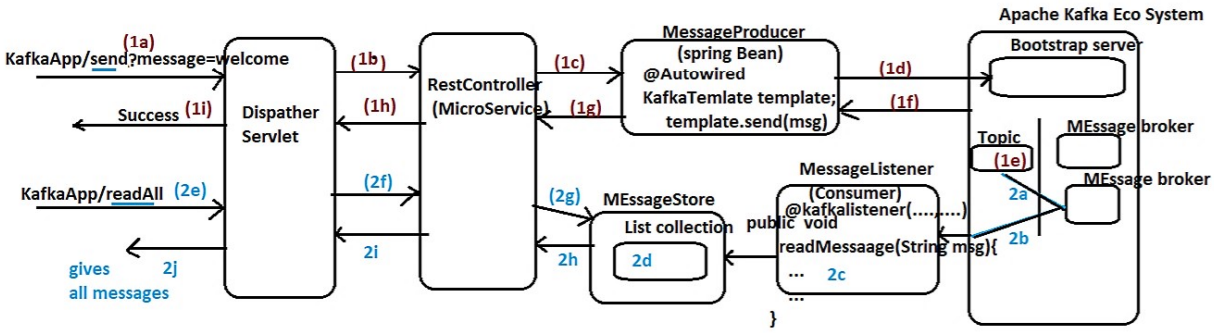
In Listener class

```
@KafkaListener(topicName="nit-tpc-fri", groupId="nit-grp1")
public void readMessage(String msg){
    ....
    .... //logic to read the message.
  }
```

=> We need to add @EnableKafka on the top of starter class (main class)

=> we can get message from endusers as request parameter through RestController/MicorService of spring MVC/Spring Rest App , So we need to make the Producer App taking message from through RestController to send kafka setup. Similarly we need to read the message from kafka setup using Consumer or MEssageListener to send to endusers through RestController.

http://localhost:4041/KafkaApp/send?message=welcome
http://localhost:4041/KafkaApp/send?message=quotation value 2000
http://localhost:4041/KafkaApp/send?message=how are u



(1a) --- 1i :: 1st request -response (message came and stored in topic section of apache kafka server from producer successfully)
(2a) --- 2j :: 2nd request-response (message sent to consumer from topic section through broker of apache kafka server successfully)

order of development
==========

=>MessageProducer having injection KafkaTemplate obj
=> Restcontroller with handler method with "/send" request path having injection of MessageProducer object
=> MessageStore
=>MessageListner injected with MessageStore
=> above Restcontroller with another handler method with "/readAll" request path having injection of MessageStore object

step1) Create spring boot starter Project adding the following dependencies web , kafka , lombok api, devtools

step2) add @Enablekafka on the top of main class/starter class.

```
@SpringBootApplication
@EnableKafka
public class BootKafkaProj2RestWithKafkaApplication {

    public static void main(String[] args) {
        SpringApplication.run(BootKafkaProj2RestWithKafkaApplication.class, args);
    }
}
```

step3) add the following properties in application.properties file

applicaiton.properties

```
#server port
server.port=4041

#context path
server.servlet.context-path=/RestKafkaApp
#topic name
app.topic.name=nit-tpc-sat1

#Producer properites
spring.kafka.producer.bootstrap-servers=localhost:9092
spring.kafka.producer.key-serializer=org.apache.kafka.common.serialization.StringSerializer
spring.kafka.producer.value-serializer=org.apache.kafka.common.serialization.StringSerializer
#Consumer properites
spring.kafka.consumer.bootstrap-servers=localhost:9092
spring.kafka.consumer.key-deserializer=org.apache.kafka.common.serialization.StringDeserializer
spring.kafka.consumer.value-deserializer=org.apache.kafka.common.serialization.StringDeserializer
```

feb 12.1 Developing Kafka Clients using spring boot kafka apis

step4) MessageProducer.java

```
package com.nt.producer;

import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.beans.factory.annotation.Value;
import org.springframework.kafka.core.KafkaTemplate;
import org.springframework.stereotype.Component;

@Component("msgProducer")
public class MessageProducer {
        @Autowired
        private KafkaTemplate<String,String>  template;
        @Value("${app.topic.name}")
        private  String topicName;

        public  String   sendMessage(String message) {
                template.send(topicName,message);
                return " message delivered ";
        }
}
```

step5) Restcontroller

```
package com.nt.controller;

import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RequestParam;
import org.springframework.web.bind.annotation.RestController;
import com.nt.consumer.MessageStore;
import com.nt.producer.MessageProducer;

@RestController
public class KafkaMessageHandlingController {
@Autowired
private  MessageProducer producer;
@Autowired
private MessageStore  store;

@GetMapping("/send")
public  String   sendMessage(@RequestParam("message")String message) {
          String status=producer.sendMessage(message);
          return "<h1>"+status+"</h1>";
}
@GetMapping("/readAll")
public   String   fetchAllMessage() {
   return  "<h1>"+store.getAllMessages()+"</h1>";
}
}
```

step6) MessageStore.java

```
package com.nt.consumer;

import java.util.ArrayList;
import java.util.List;
import org.springframework.stereotype.Component;
@Component
public class MessageStore {
        private List<String> listMessages=new ArrayList();
        public void   addMessage(String message) {
                listMessages.add(message);
        }
        public  String   getAllMessages() {
                return  listMessages.toString();
        }
 }
```

step7) MessageConsumer.java

```
package com.nt.consumer;

import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.kafka.annotation.KafkaListener;
import org.springframework.stereotype.Component;
@Component
public class MessageConsumer {
        @Autowired
        private MessageStore store;
        @KafkaListener(topics = "${app.topic.name}",groupId = "grp1")
        public void  readMessage(String message) {
                //add  message to store
                store.addMessage(message);
        }
 }
```

Execution order

i) start bootstrap server (zookeeper)

```
E:\kafka_2.13-3.1.0\bin\windows>zookeeper-server-start.bat E:\kafka_2.13-3.1.0\config\zookeeper.properties
```

ii) start kafka server setup

```
E:\kafka_2.13-3.1.0\bin\windows>kafka-server-start.bat E:\kafka_2.13-3.1.0\config\server.properties
```

note:: No need of creating topic seperately .. @EnableKakfa will take care of creating topic dynamically

iii) Run the application as spring boot App or on server
and give requests

```
http://localhost:4041/RestkafkaApp/send?messsage=raja
http://localhost:4041/RestkafkaApp/send?messsage=rani
http://localhost:4041/RestkafkaApp/send?messsage=hello
http://localhost:4041/RestkafkaApp/readAll
 [raja,rani,hello]
```

feb 15 Distributed Tracking&Logging Using slueth -zipkin

Distributed Logging and Tracing

Tracing :: Finding out execution flow /path from request to response is called Tracing

Logging :: Finding out various lines of code and various comps that are involved in the flow of execution having different Logger Levels like DEBUG,INFO,WARN and etc.. is logging

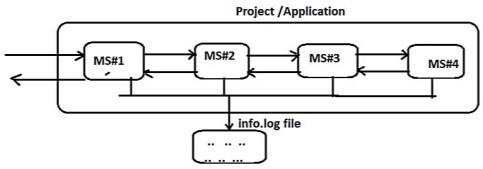
Intra communication of MicroServices

=>It speaks about the communication that happend between multiple microseervices.
=>The request given to one MS taking to another MS is called Intra communication b/w MicroServices.

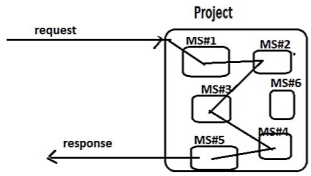
Distributed Logging and Tracing

=>When the MicroServices are in intra communication enabling tracing and logging activities across the multiple MicroServices to findout exection flow of each and every request to response called Distributed Tracing and Logging.

=>This will enabled on multiple MicroServices for one time to help new developers/ testers /debuggers /UAT team to know execution flow from request to response across the multiple MicroServices for ever.



=> Logging is extension of Tracing .. In fact logging a kind of tracing activilty .. The only difference is the logging activity writes its log messages to destination called file/Db/mailserver and etc. having ability to filter the messages based on the Logger Levels we have choosen.



if execution is taking place across the multiple MicroSerivces then we need the support of Distributed Logging and Tracking.

Slueth and Zipkin : These two are components/ tools provided by the spring cloud env.. to enable distributed Logging and tracing on MicroSerivces that are in Intra communication.

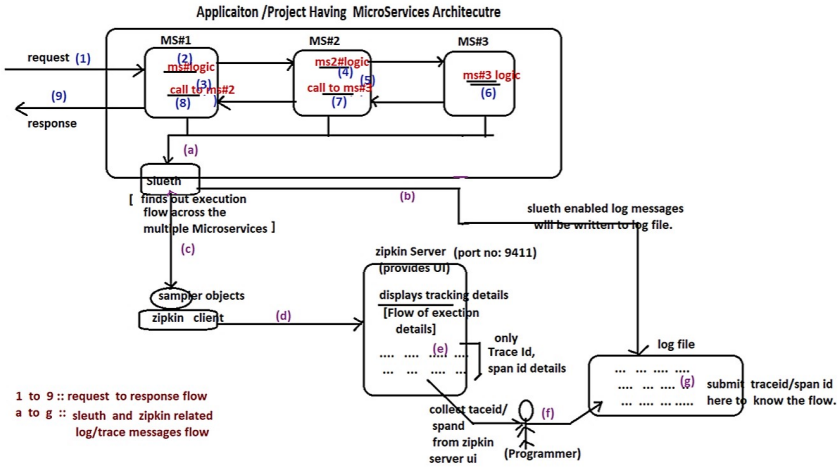
Slueth :: A spring cloud comp providing unique id for each request flow ... The Programmer can use this unique ids to find out the execution flows of requests.

Two types of Ids

traced Id :: unique id for each request flow across the multiple micro services.. if developers gets this traced id he can find out all the microservices that are involved in a request flow.

span id :: Unique id given for each micro service .. if developer gets this span id then he can findout all the executions that happend in a micro service.

Zipkin Client :: We need to add Zipkin dependency to every MS along with sleuth dependency .. It contains sampler obj nothig but the data collected from MicroServices using Slueth tool to Zipkin Server) So it can provide lots of details related trace id , spanid and etc.. with respect to the Distributed loggig and tracking enabled on across the multiple microservices.



Zipkin Server :: provides UI env.. running on the port number (9411 default) The zipkin clients of each Ms collects trace ids/spand ids of distributed tracking, logging from slueth comp and gives to zipkin server to display having UI.

note:: while working with Distribued Logging and tracing each MS contains its own zipclient and slueth comp..but there must be only one zipkin server as centralized server that collects data from all zipkin clients of different MS as sampler objs to display as UI.

note :: The develop /programmer collects trace id/span id from zipkin server ui and seraches in the distributed log file generated by the slueth to find out log messages for flow of execution.

Q) In One Project of MicroServices architecture , can u tell me how many micros serivces will be there?
ans) Mulitple as needed

Q) What is microServices Intra communication
ans) It is the communication b/w microservices (One Ms to another MS communication)

Q) In MicroSerivces Intra Communication , how can we find out which comps of which microservices are executed in the request flow?
Ans) We need enabled distributed logging / tracing on multiple Microservices that are in intr Communication.
(In this process every MS should have slueth and zipkin client support connected to the centralized zipkin server)

Q) When to use log4j and when to use slueth and zipkin?
Ans) log4j is required to write log message in both indepndent Microservices execution and the Intra communication enabled microservices execution .. But we link log4j with slueth and zipkin to write the log4 generted log mesage having trace ids and span ids which helps distributed logging and tracing.

Keeping Zipkin Server ready

step1) download jar file that represents zipkin server

https://zipkin.io/pages/quickstart ----> go to java section --->
click on latestrelease which gives "zipkin-server-2.23.16-exec.jar" representing zipkin server.

step2) start zipkin server ..

copy "zipkin-server-2.23.16-exec.jar" file to u r choice and execute the jar file

```
E:\zipkinserver>java -jar zipkin-server-2.23.16-exec.jar
```

step3) open zinkin server home page

http://localhost:9411/zipkin/

feb 16 Distributed Tracking&Logging Using slueth -zipkin

Example App

==========

=>Keep Zipkin server running mode

=> develop 3 microservices having intra communication + zipkin client and slueth support and execute them

=> Give request to First MicroService

=> perform the following operations in zipkin server console

a) open the home page ::http://localhost:9411/zipkin

b) Click on FindTrace

c) Click on BlueColor Bar

d) Click any One Option (App1 --First MicroSerivce name)

e) collect and copy the TraceId

f) open the log file (App.log) and serach for (ctrl+f) traceId to see all the log messages realated to current request

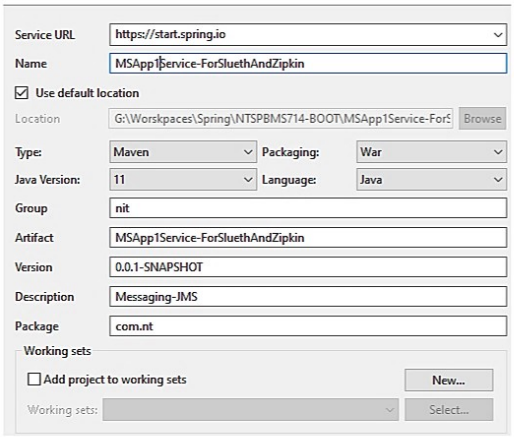
MicrServices Development

==========

First MicroService (App1)

---

a) create spring boot starter project of type war file adding web,lombok , slueth, zipkin client dependencies



for this app 2.5.9 parent starter is used

2.6.x is not working

add these starters

b) Add the following entries in application.properties

application.properties

```
server.port=9091
spring.application.name=App1
logging.file.name=E:/logs/App.log
```

c) create objects to make them as spring beans using @Bean methods in @Configuration class

AppConfig.java

==========

```
package com.nt.config;

import org.springframework.context.annotation.Bean;
import org.springframework.context.annotation.Configuration;
import org.springframework.web.client.RestTemplate;
import brave.sampler.Sampler;
@Configuration
public class AppConfig {
	@Bean
	public  Sampler  createSampler() {
		return  Sampler.ALWAYS_SAMPLE;
	}
	@Bean
	public  RestTemplate  createRestTemplate() {
		return new  RestTemplate();
	}
}
```

d) Develop RestController as MicroService

```
package com.nt.controller;
import org.slf4j.Logger;
import org.slf4j.LoggerFactory;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RestController;
import org.springframework.web.client.RestTemplate;
@RestController
public class ShoppingOperationsController {
	@Autowired
	private  RestTemplate  template;
	Logger logger=LoggerFactory.getLogger(ShoppingOperationsController.class);

	@GetMapping("/shopping")
	public String Shopping() {
		logger.info("Welcome to shopping Module");
		//communicate with  BillingSErvice
		String  resp=template.getForObject("http://localhost:9092/billing", String.class);
		logger.info("Back to  shopping module::"+resp);
		return  resp;
	}
}
```

feb 16.1 Distributed Tracking&Logging Using slueth -zipkin

note: Develop Second MicroServcie and Third MicroSerivce in similar fashion having neccessary chanages
note:: Second MS communicates with Third Ms .. but Third MS does not interact with any Ms
note:: Registering these MicroServices with Eureka is optional .. but recomanded to do..

Second MicrService
==========
=>Project creation :: same as first mS
=>AppConfig.java :: same as first MS
=>application.properties

```
server.port=9092
spring.application.name=App2
logging.file.name=E:/logs/App.log
```

=>Rest Controller class

```
package com.nt.controller;
import org.slf4j.Logger;
import org.slf4j.LoggerFactory;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RestController;
import org.springframework.web.client.RestTemplate;
@RestController
public class BillingOperationsController {
        @Autowired
        private RestTemplate template;
        Logger logger=LoggerFactory.getLogger(BillingOperationsController.class);
        @GetMapping("/billing")
        public String doBilling() {
                logger.info("Welcome to Billing Module");
                //communicate with PaymentSErvice
                String resp=template.getForObject("http://localhost:9093/payment", String.class);
                logger.info("Back to Billing module::"+resp);
                return resp;
        }
}
```

Third MicroService Development
==========
=>Project creation :: same as first mS
=>AppConfig.java :: same as first MS
=>application.properties

```
server.port=9093
spring.application.name=App3
logging.file.name=E:/logs/App.log
```

RestController class

```
import org.slf4j.Logger;
import org.slf4j.LoggerFactory;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RestController;
@RestController
public class PaymentOperationsController {
        Logger logger=LoggerFactory.getLogger(PaymentOperationsController.class);
        @GetMapping("/payment")
        public String doBilling() {
                logger.info("Welcome to payment Module");
                return "payment is done";
        }
}
```

To run the Application
==========

=>Keep Zipkin server running mode

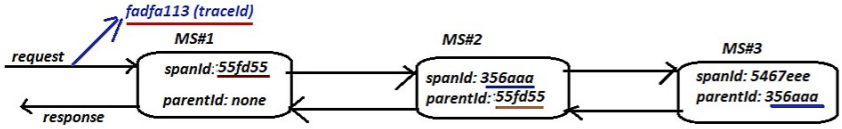
```
E:\zipkinserver>java -jar  zipkin-server-2.23.16-exec.jar
```

=> develop 3 microservices having intra communication + zipkin client and slueth support and execute them
order of execuion :: 3rd , 2nd and 1st

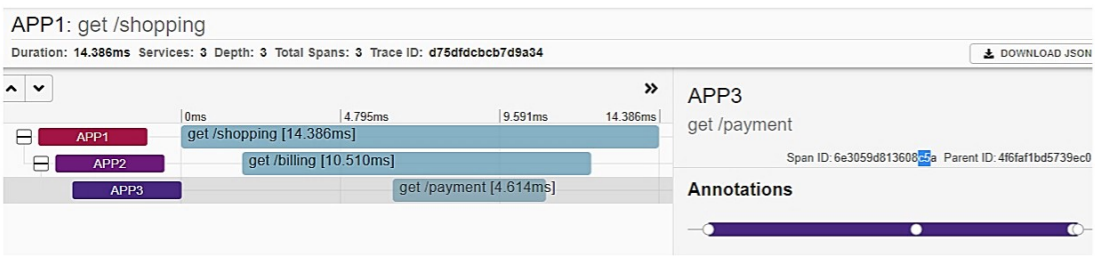
=> Give request to First MicroService

http://localhost:9091/shopping

=> perform the following operations in zipkin server console *+ log file*
a) open the home page ::http://localhost:9411/zipkin
b) Click on FindTrace
c) Click on BlueColor Bar *(Run query)*
d) Click any One Option (App1 --First MicroSerivce name)
e) collect and copy the TraceId
f) open the log file (App.log) and serach for (ctrl+f) traceId to see all the log messages realated to current request



spanId current MS = parent Id of next MS (nothing but current MS spanId will becomes parent id for next MS)



feb 17 API Gateway -zuul

API -Gateway

=> Different MicroServices of project run on different port numbers having different urls .. it is pratically impossible to remember all those port numbers and urls seperately.. So we need single entry and exit point having unique url for all the micro services of the App ..that is API gateway

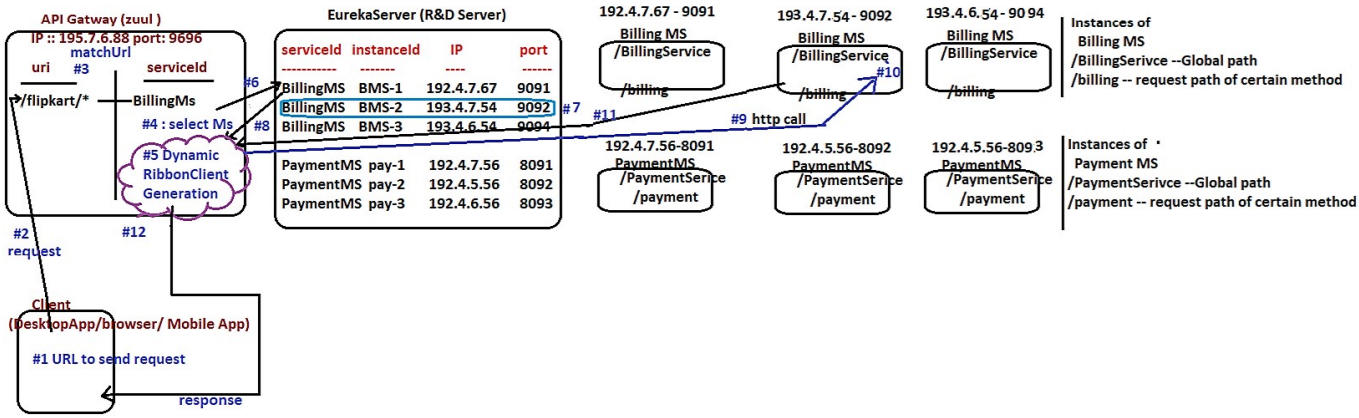
API Gateway provides
==========
=> Acts as single entry and exit point for the application (For all the micro services of the application)
=> Can perform Authentication and Authorization (Security)
=> Provides Filters for Data /request logging (To find out flow related to request/response/error)
=> Dynamic Routing to the instances of MicroServices (Intenrally uses Ribbon Client Code (Proxy Client code)for this)
=> API Gateways also one kind of MicroService Which is able to call all other MicroSErvices of the application or Project using Eureka s erver.

note:: Eureka Server is for registering microService and for finding MicroService ...
Eureka server itself can not communicate with other MicroService in any angel .One MS gets details of other MS from EurekaServer using one or another client code (like LBC, Feign Client and etc..) later uses RestTemplate support to make http call from One MS(source) to another Ms(Destination).

conclusion :: Eureka Server can not communicate with Ms and can not make http calls to interact with any Ms .. It Is just there to register details of One MS, So other MS can use one or another Client Code to find the details about MS(dest) and to interact with that MS (dest)

What is API Gateway ? what is use of it?

=> It provides single entry and exit point all for MicroServices of the Application/ Project.. It itself acts as MicroService having ability to take http requests from Clients and to communicate with other MicroSErvices using http calls through EurekaServer by Generating RibbonClient Code as Proxy code.



URL in the client App
==========
syn :: http://<zuulIP>: <port>/<zuulpath>/<MsGlobalPath>/<Ms Method or req path>
eg:: http:// 195.7. 6.88:9696 / flipkart/BillingService/billing

=> Zuul (API gateway) is also one MS , registering with Eureka
=> Zull Generatoes Client Code to interact with EurekaServer Dyanically as InMemory Proxy class in the form RibbonClient
=> Zuul interacts with Eureka Server using Dynamic Client Code to get Less Load instance (load balance)
=> The dyanamically generated Client code in Zuul makes http request to communicate with MS whose instanace is gathered from EurekaServer .. later it sends the recieved output to Client as response

With respect to the diagram
==========
#1 :: enduser give URL to Client App/Browser to send request
#2 :: The url based generated request goes to Zuul (API gateway)
#3 :: Zuul matches/compares current request url with common paths/zuul paths that are maintained by linking with serviceIds
#4 :: Selects One Service Id based on the matching zuul /common path
#5 :: Generates Dynamic Client Code (as In Memory Proxy class) as Ribbon Client Code
#6 ,#7,#8 :: This Ribbon Client Code contacts the EurekaServer and gets less load balance instanceId of matched MS
#9 : Ribbon Client generates http call to interact with recieved instance id based MS instance
#10,#11 :: Based on the global path , method path of the URL ... the method in MS intance will execute and the generate results comes back Ribbon Client
#12 :: Ribbon Client sends the results to Client App/Browser as response