



APIs: The Digital Connectors

Gateway to Digital Transformation

Lakmal Warusawithana

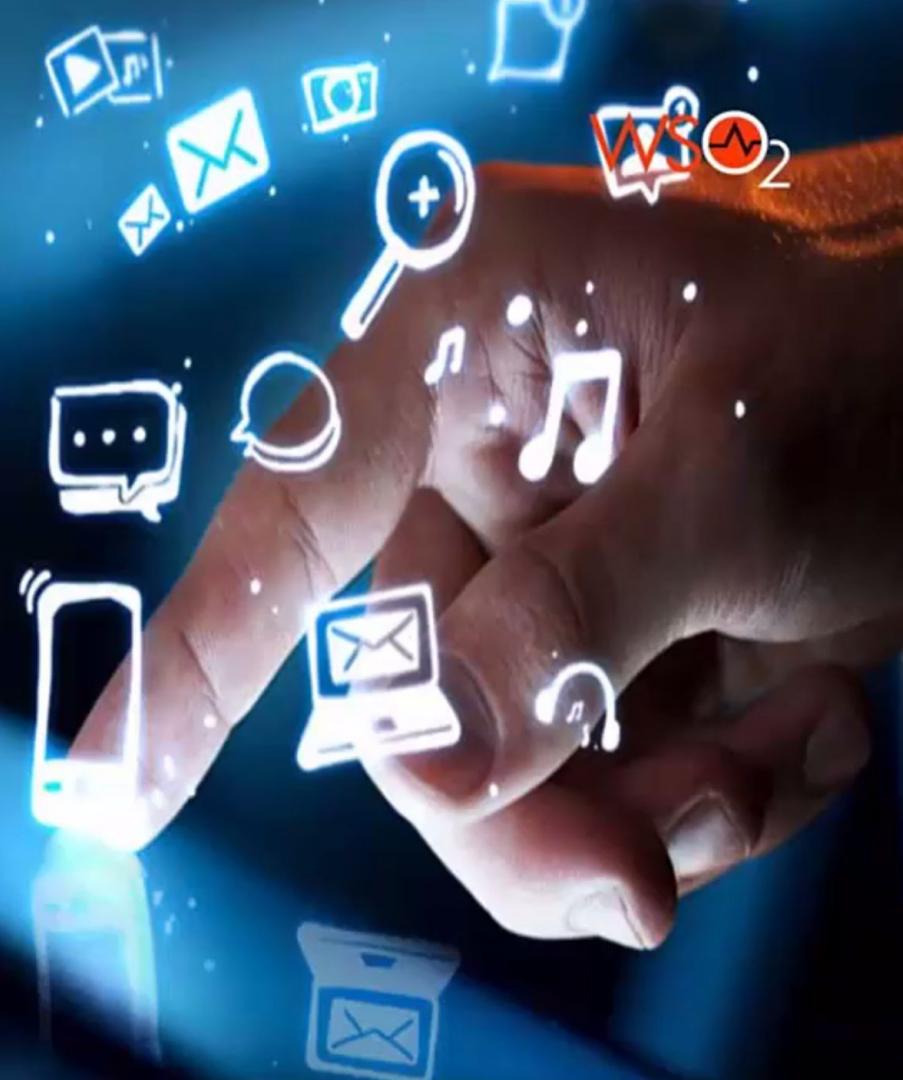
Director Cloud Architecture

May, 2017

Digital Transformation

is all about Digital Experience

Digital
Transformation is all
about creating a
“Digital Experience”
for your customers



Amazon GO





**It's not just about
becoming "Paperless"**

UBER



UBER

Ride

Drive

Cities

Get there
Your day belongs to you



Lottery

The image shows two screenshots of a mobile phone's messaging app interface. Both screenshots have a red dashed border at the top.

Screenshot 1 (Left):

- Top status bar: Mobitel LK, 2:23 PM, 73% battery.
- Message from 'Lucky889':

Successfully Subscribed to Supiri Vasana Sampatha. Draw dates: every Wed & Sat. Charges: Rs.20+ (telecom fee+Tax) per ticket. To Unsubscribe SMS SV OFF to 889. T&C please dial [0117889889](#)
- Time: Sun, Apr 23, 10:59 AM
- Message to 'Lucky889':

Rs.20.0 win from Supiri Vasana Sampatha is added to your wallet. Now you can buy tickets from your wallet. Current wallet balance is Rs.20.0 Call [117889889](#)
- Time: Wednesday 10:37 PM
- Message from 'Lucky889':

Rs.20.0 for Supiri Vasana Sampatha is charged from your wallet. Current wallet balance is Rs.0.0 Call [117889889](#)
- Time: Friday 4:22 PM

Screenshot 2 (Right):

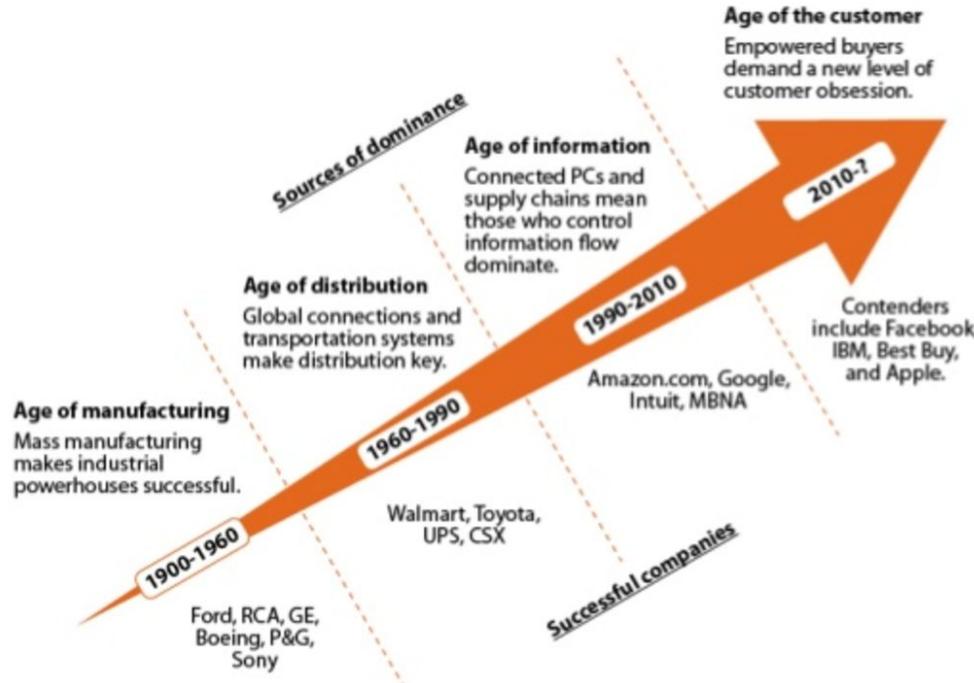
- Top status bar: Mobitel LK, 8:32 PM, 81% battery.
- Message from 'Supiri Vasana Sampatha':

Lottery - Supiri Vasana Sampatha
Draw No - 1217
S/N - [12170568673](#)
Ticket No - 23 8 9 22 47
Draw Date - 2017-04-26
Good Luck from Lucky889!
T&C dial [0117889889](#)
- Time: Wednesday 10:25 PM
- Message to 'Supiri Vasana Sampatha':

Congratulations! It's your lucky day!, You have won 20.0 for Supiri Vasana Sampatha [12170568673](#) [23 8 9 22 47](#) on 2017-04-26.

At the bottom of both screenshots are standard mobile message controls: camera, heart, reply, text message, and send.

The age of the Consumer



Source: June 6, 2011, "Competitive Strategy In The Age Of The Customer" Forrester report

Following the Consumer



Connected Experience



Start your day off right.



"Alexa, tell Starbucks
to start my order."

Get started •



Top enabled skills



"Alexa, open
Thunderstorm
Sounds"



"Alexa, Play
Jeopardy!"



"Alexa, open Rain
Sounds"



"Alexa, open ocean
sounds"



"A

Ambient Noise: Thunderstorm Sounds
★★★★★ 508

Jeopardy! J6
★★★★★ 483

Ambient Noise: Rain Sounds
★★★★★ 294

Ambient Noise: Ocean Sounds
★★★★★ 176

Ditty
★★★★★ 168

Customer favorites this week



"Alexa, tell Bed Time
Story to Debbie"



"Alexa, Inspire Me."



"Alexa, open
Curiosity."



"Alexa, ask Chineasy
for today's lesson."



"'''

Connected Experience

Europe by train made easy

Buy train tickets for the UK and across Europe. Simple, fast rail booking.

Roma Termini → Lucerne

ONE-WAY RETURN

DEPARTING Today 20 00

PASSENGERS 1 Adult (26-59yr)

Add railcard

More options Add new passenger type

Building a Connected Experience

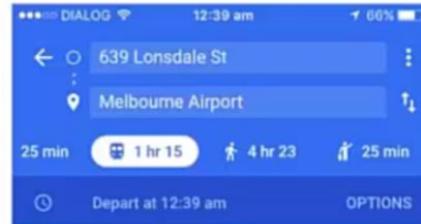
Search accommodation with Airbnb

Find trains

Available on the App Store

Connected Experience

API Complementing Each Other



1 hr 15 min
5:26 - 6:41 am
Every 12 min from Skybus Coach Terminal

1 hr 33 min
6:48 - 8:21 am
6:54 am from Southern Cross Station

1 hr 39 min
7:42 - 9:21 am
7:48 am from Southern Cross Station

Uber 25 min
Free first ride (up to A\$5)
A\$36-47
Estimate for uberX. Excludes tolls. Actual fare may vary.



Economy



uberGO
LKR620.81



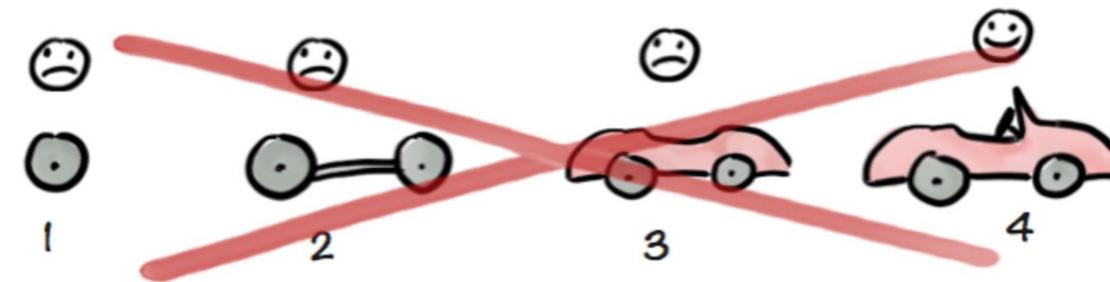
uberX
LKR977.62

1-4

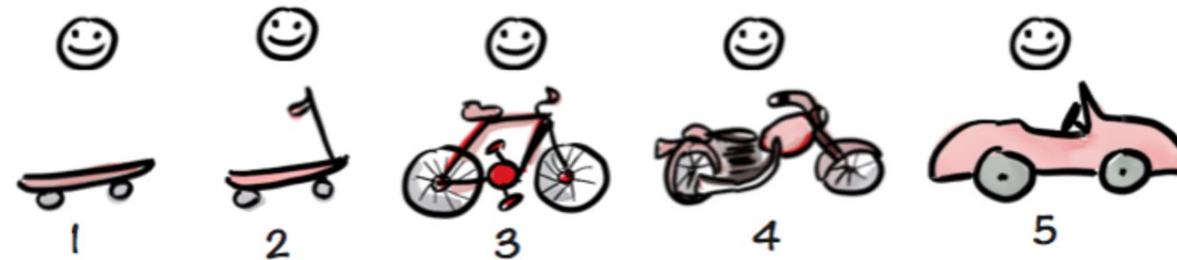
REQUEST UBERGO

Minimal Viable Product (MVP)

Not like this....

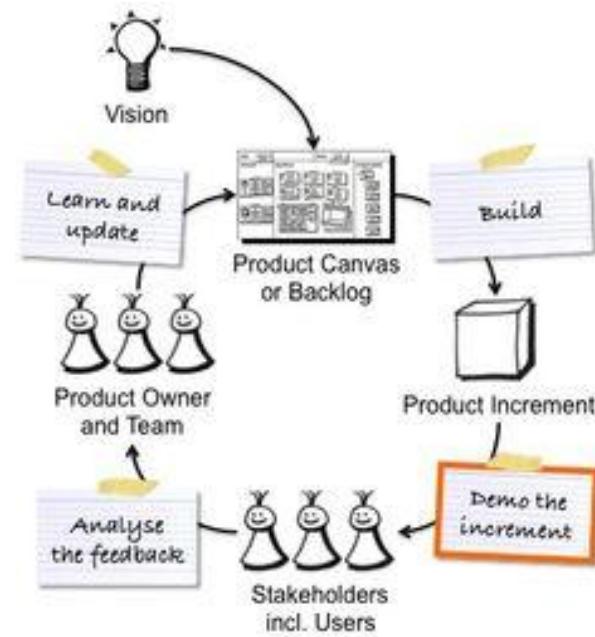


Like this!



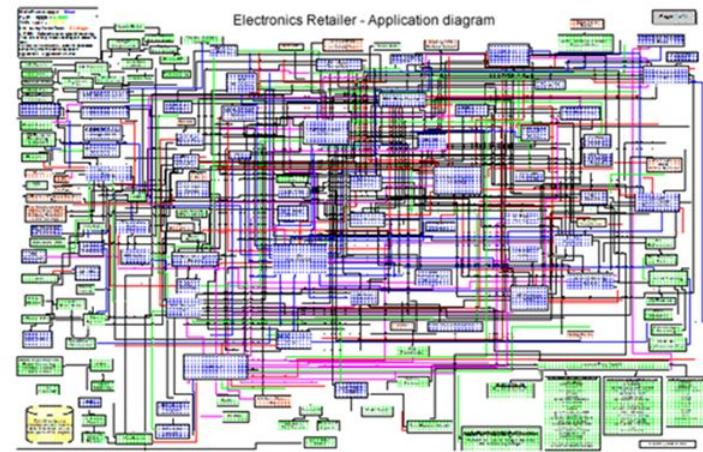
The Agile Enterprise

- Enterprises thrive to be more adaptive
- They understand that the market need changes by the day
- Organizations have to enable organic growth via new channels
- New challengers but new opportunity



Reality of Enterprise Systems Landscape

- Enterprise systems are complex
- Enterprise systems are bureaucratic
- Cannot afford the luxury of complete re-write or having a clean slate
- Comes with years of baggage



The Sliding Window Effect of Enterprise Architecture



*Mainframes
... with monoliths*



*Distributed systems
... with monoliths
... then SOA*

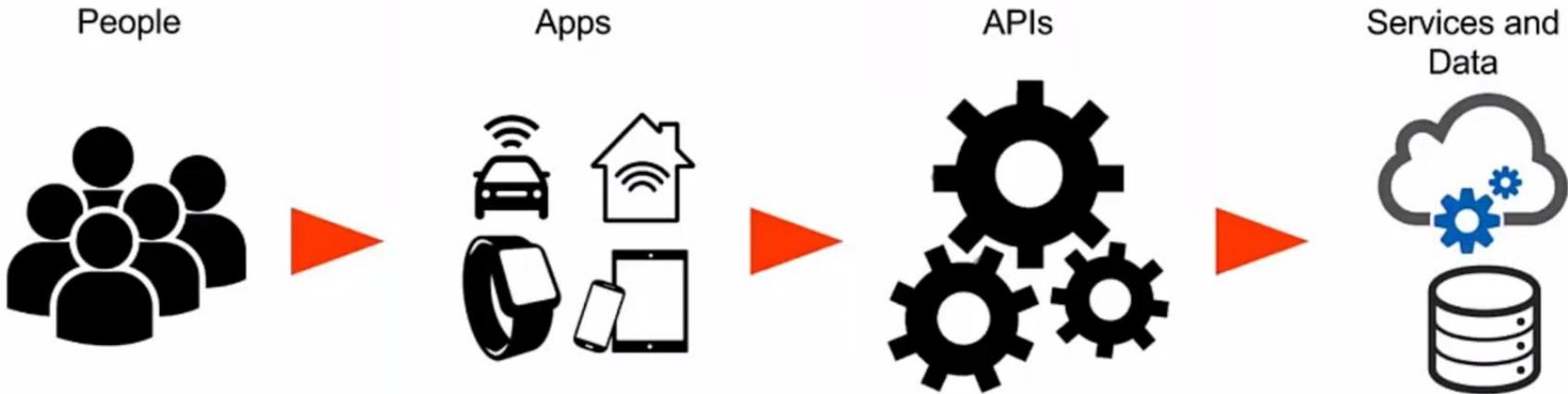


*Cloud servers
... with monoliths
... then SOA
... then micro-services*



Digital Platform

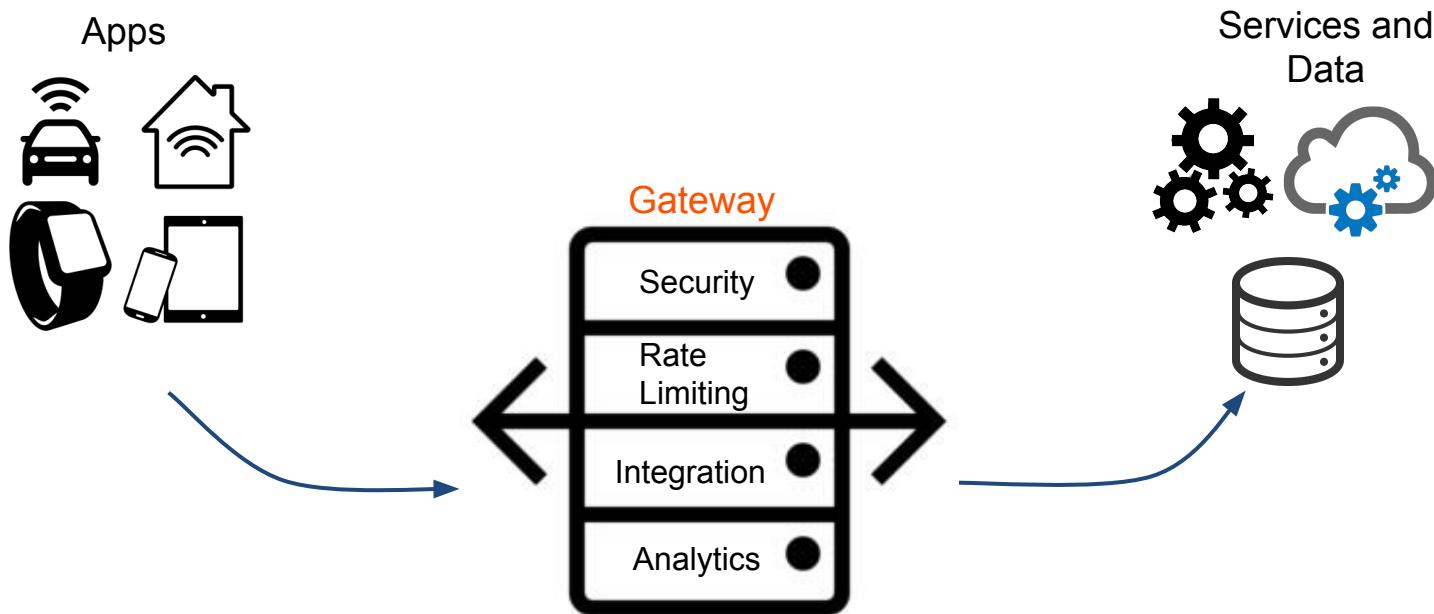
A Digital Platform



Key Performance Factors of an API Platform

- Security
- Rate Limiting
- Integration
- Analytics

API Gateway



Security: Identity

- Authentication
- Single Sign On
- Federation
- Authorization

Authenticate via Facebook to Airbnb APIs

Login By Facebook

Returns an access_token, given a valid Facebook user OAuth access token. See [the Facebook docs](#) to learn how to generate an FB access token.

NOTE: The returned access_token is required to hit logged-in endpoints.

Method: HTTP POST

Endpoint URL: <https://api.airbnb.com/v1/authorize>

Complete Curl Request (Press "Send to Hurl.it" to send in-browser test request):

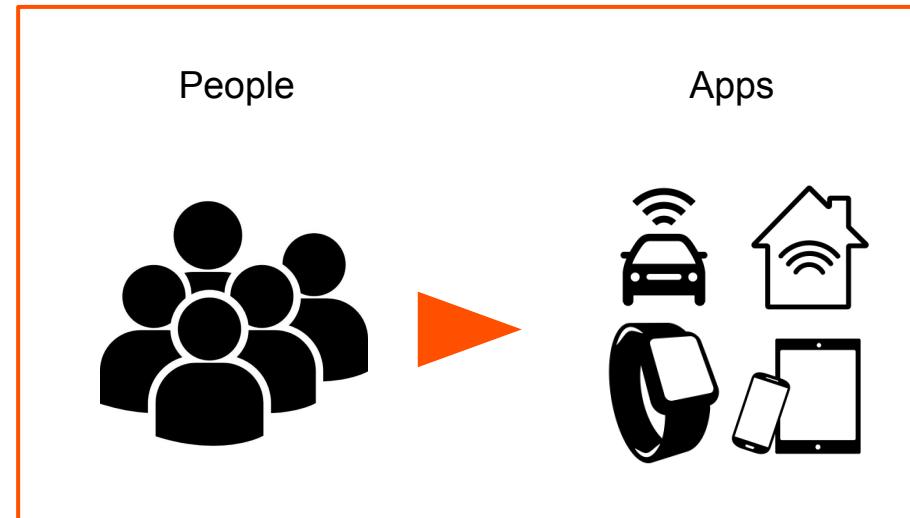
```
curl -X POST  
-d "client_id=3092nxybyb0tqw18e8nh5nty"  
-d "locale=en-US"  
-d "currency=USD"  
-F assertion_type=https://graph.facebook.com/me  
-F assertion=CAAAIEMtwcwBAMT070riSczKIgT3Nv0EnaZBWm0bwt914W  
-F prevent_account_creation=true  
https://api.airbnb.com/v1/authorize
```

[Copy to clipboard](#)

[Send to Hurl.it](#) [embedcurl.com by Runscope](#)

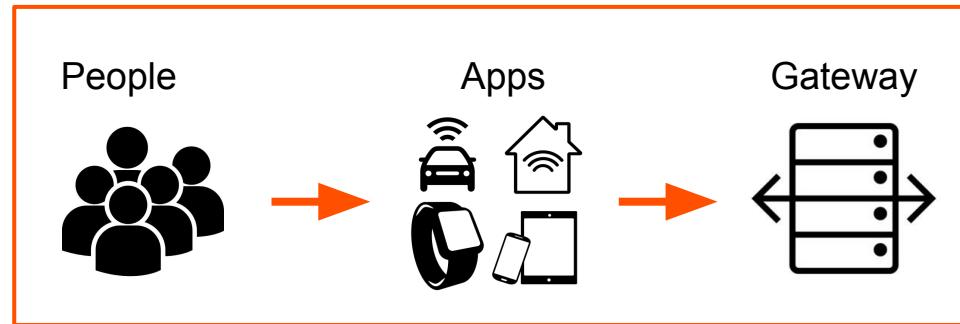
Security: Access Delegation

- Secure Trusted Clients
- Secure Untrusted Clients
- Unsecure Clients
- System to System Auth/z



Rate Limiting: Front End

- Monetization
- Burst Control
- Fair Usage Policy
- Geographical Distribution
- Distribution by Device Type

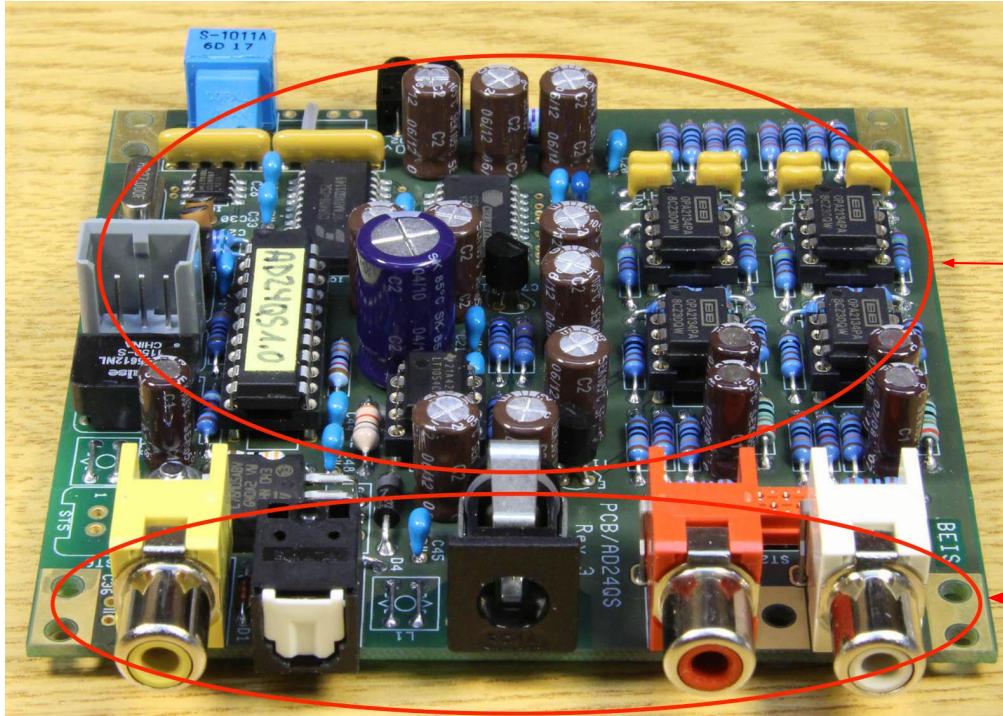


Rate Limiting: Back-End

- Prevent Total Service Outage at Peaks
- Back-End Server Maintenance



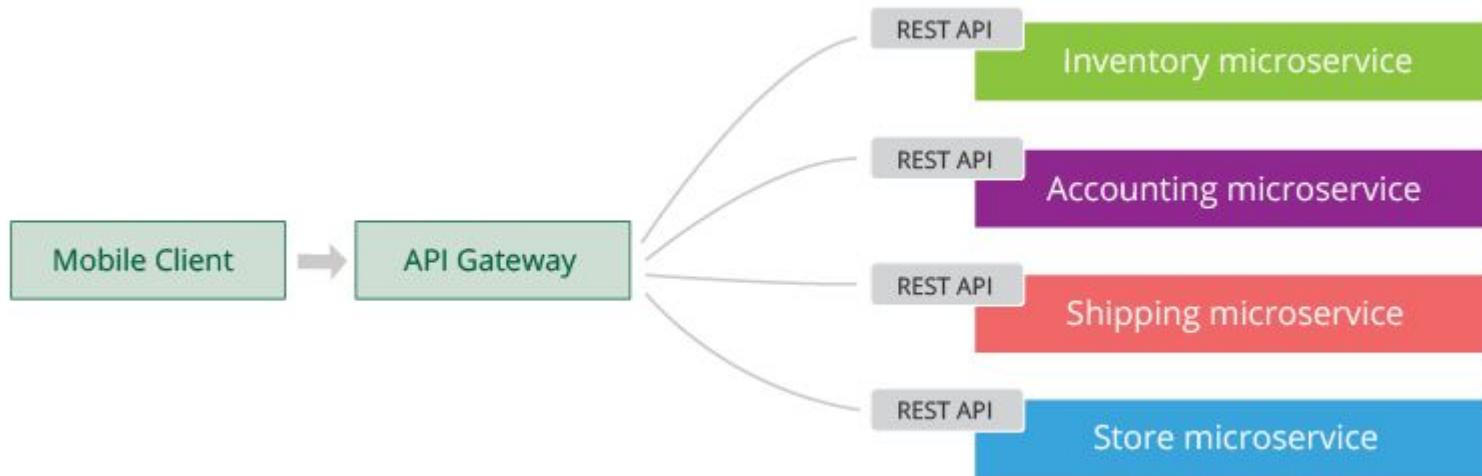
Integration



Integration

Interface

Integration



Integration

The Problem!

“At present tooling for API gateways is achingly immature and so while defining applications with API gateways is possible it’s most definitely not for the faint-hearted.”

Mike Roberts, August 2016 - “Serverless Architectures” on martinfowler.com

Integration

The Solution



Ballerina

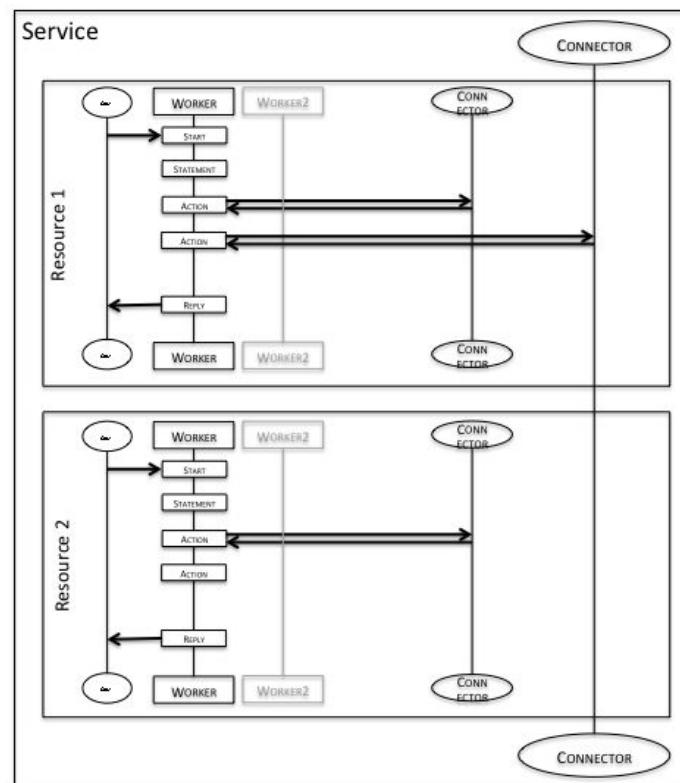
Flexible. Powerful. Beautiful.

Ballerina is a programming language that lets you
create integrations with diagrams.

ballerinalang.org



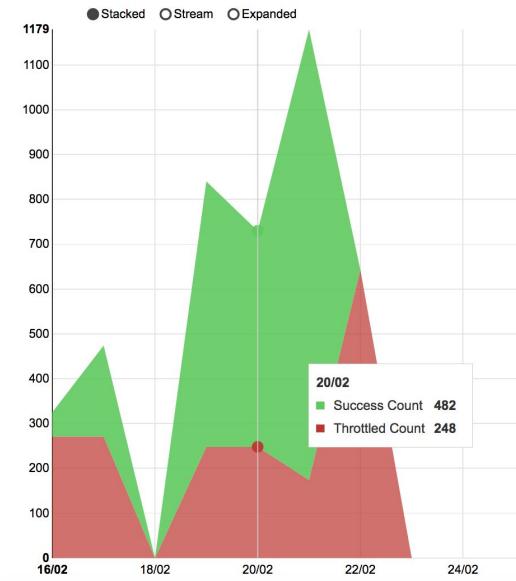
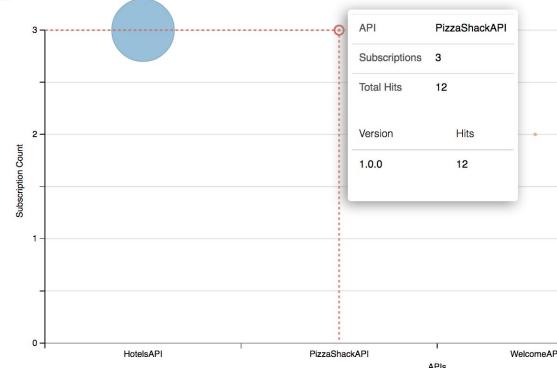
Ballerina



Ballerina

```
1 package restfulservice.samples;
2 import ballerina.net.http;
3
4 @http:BasePath ("/ecommerce")
5 service Ecommerce {
6     http:ClientConnector productsService = create http:ClientConnector("http://localhost:9090");
7
8     @http:GET
9     @http:Path ("/products/{productId}")
10    resource productsInfo(message m,
11        @http:PathParam("productId") string prodId) {
12        string reqPath = "/productsservice/" + prodId;
13        message response = http:ClientConnector.get(productsService, reqPath, m);
14        reply response;
15    }
16
17
18    @http:POST
19    @http:Path ("/products")
20    resource productMgt (message m) {
21        message response = http:ClientConnector.post(productsService, "/productsservice", m);
22        reply response;
23    }
24}
25
```

Analytics: Statistical Analysis



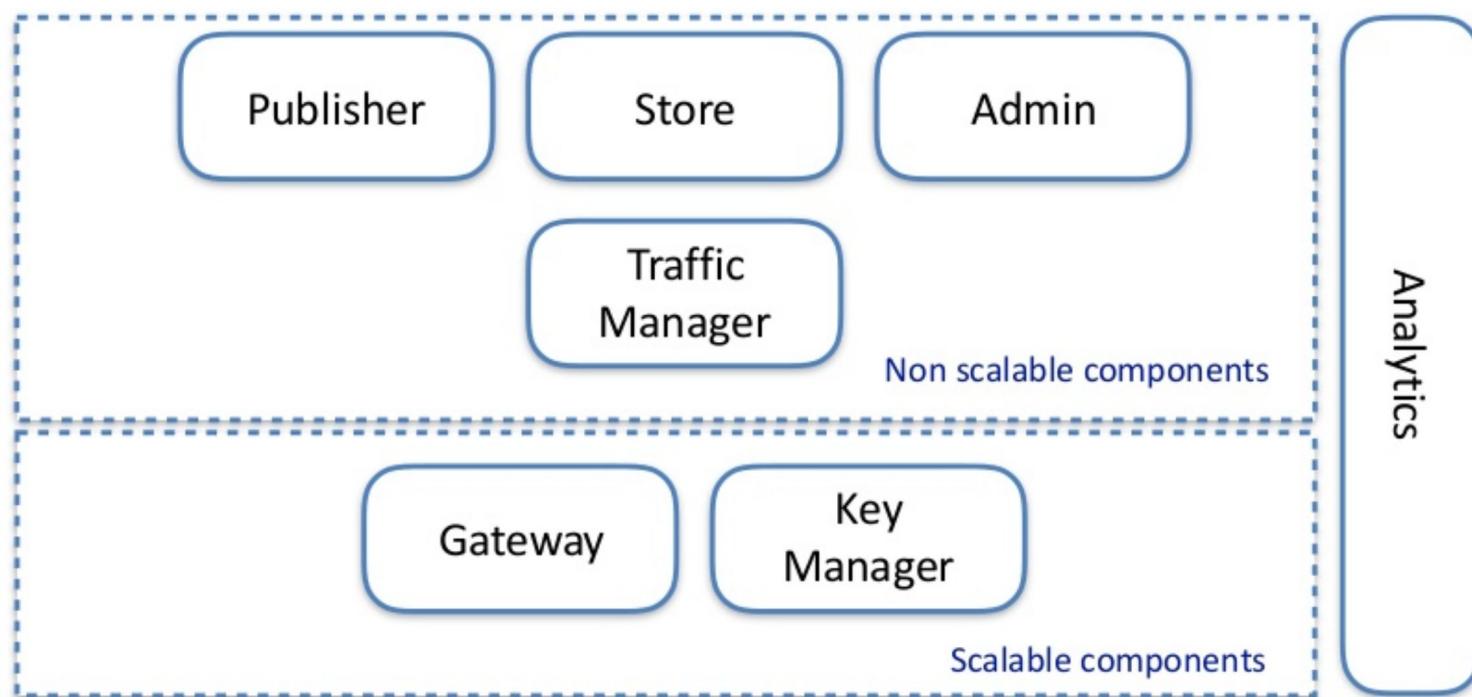
Analytics: Operational

- API Latency Distribution
- Alerting on Abnormalities
- API Health



Deep Dive into WSO2 API Manager

Understanding API Manager Components



Understanding the Storage

Storage Types

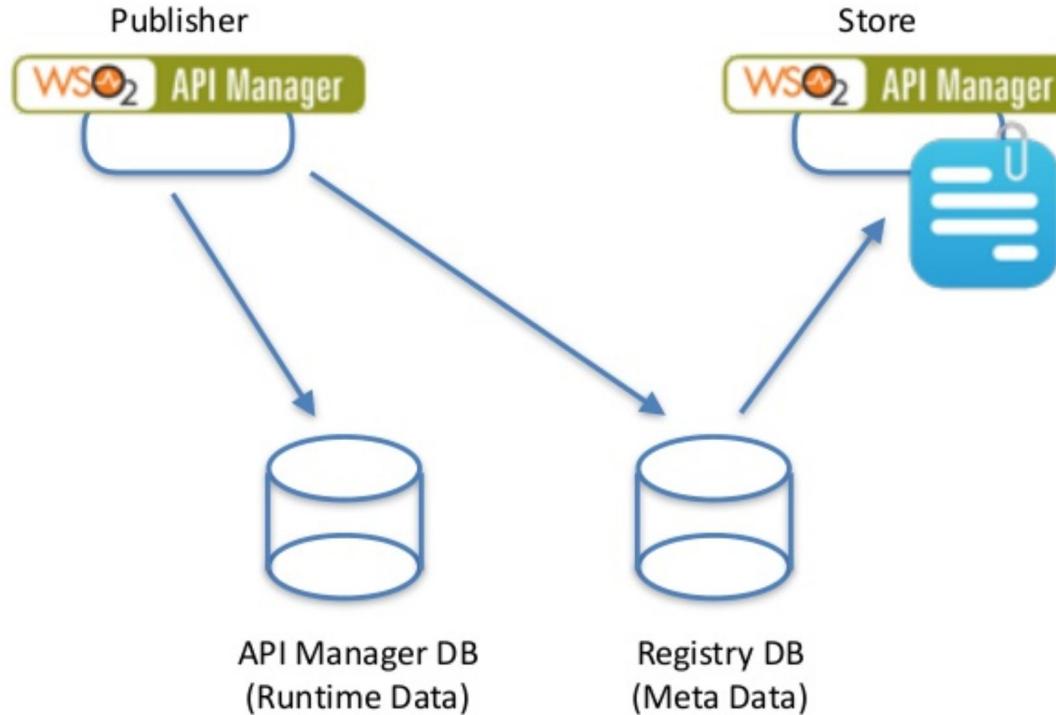
- Registry Database - Stores API Metadata, Tenant Key Stores, Documents, Tags
- API Manager Database - Stores API Runtime Data, Application Data, Token Data, etc
- Permissions Database - Stores role to permissions and user to permissions mappings
- Analytics Summary Database - Stores API/Application usage summary.

Understanding the Storage

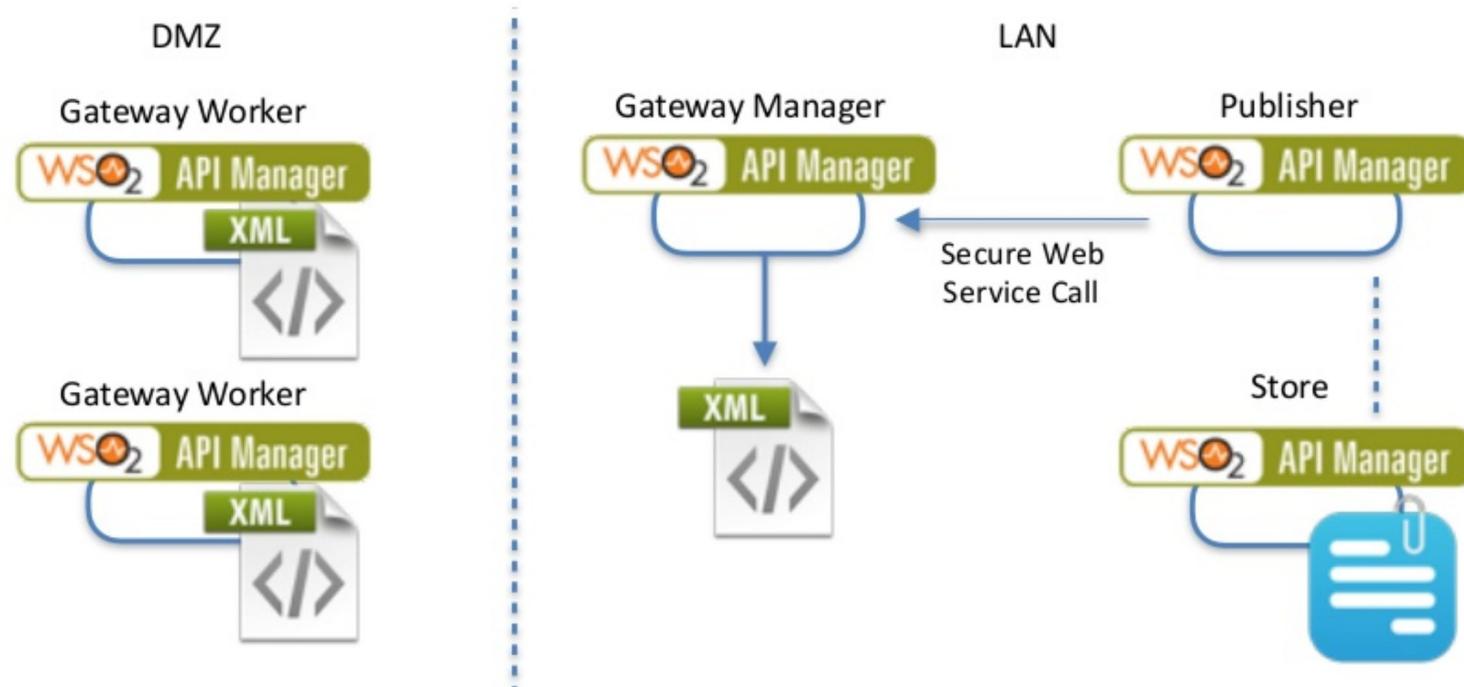
Understanding read/writes

Component	Reads only from	Writes to
Publisher	Permissions DB, Analytics DB	Registry, APIM DB
Store	Permissions DB, Analytics DB, Registry	APIM DB
Key Manager		Permissions DB, APIM DB, Registry
Traffic Manager	Permissions DB	

Create an API



Publishing an API



API: The runnable artifacts

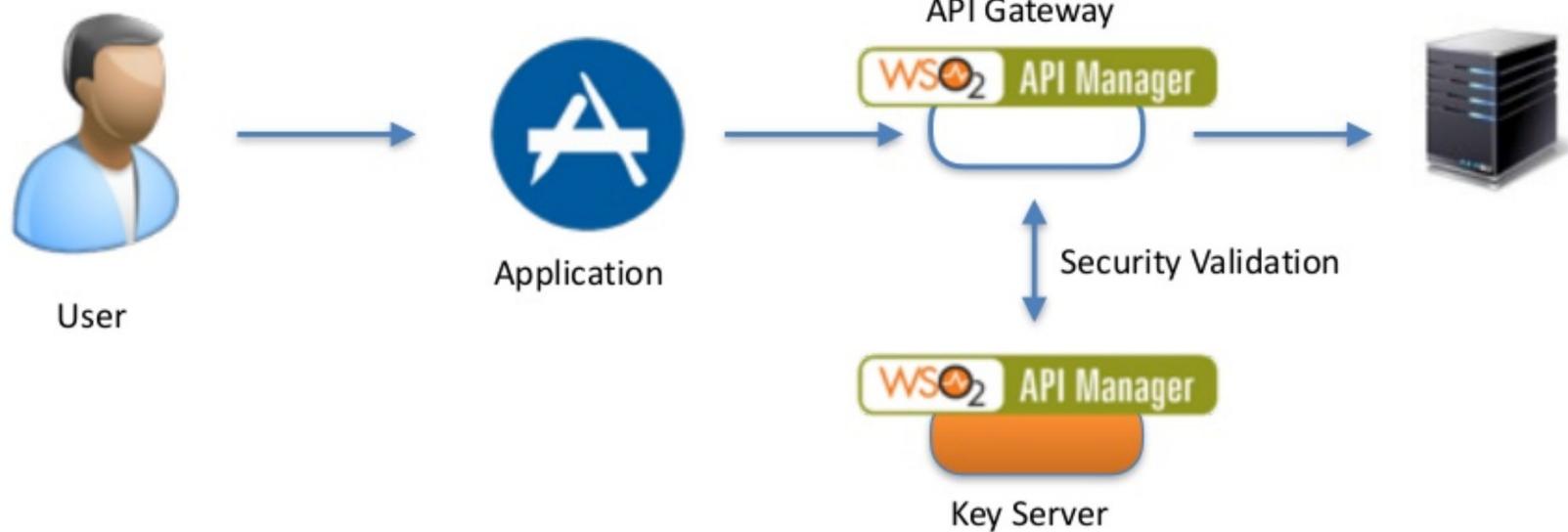
```
<api name="nuwan--Petstore"
    context="/petstore/1.0.0"
    version="1.0.0"
    version-type="context">

    <resource methods="POST PUT" url-mapping="/pet">
        ...
    <resource methods="DELETE PUT GET"
        uri-template="/user/{username}">
        ...
    <handlers>
        <handler
            class="org.wso2.carbon.apimgt.gateway.handlers.security.APIAuthenticationHandler">
            ...
        </handler>
    </handlers>
```

API: The handler Flow

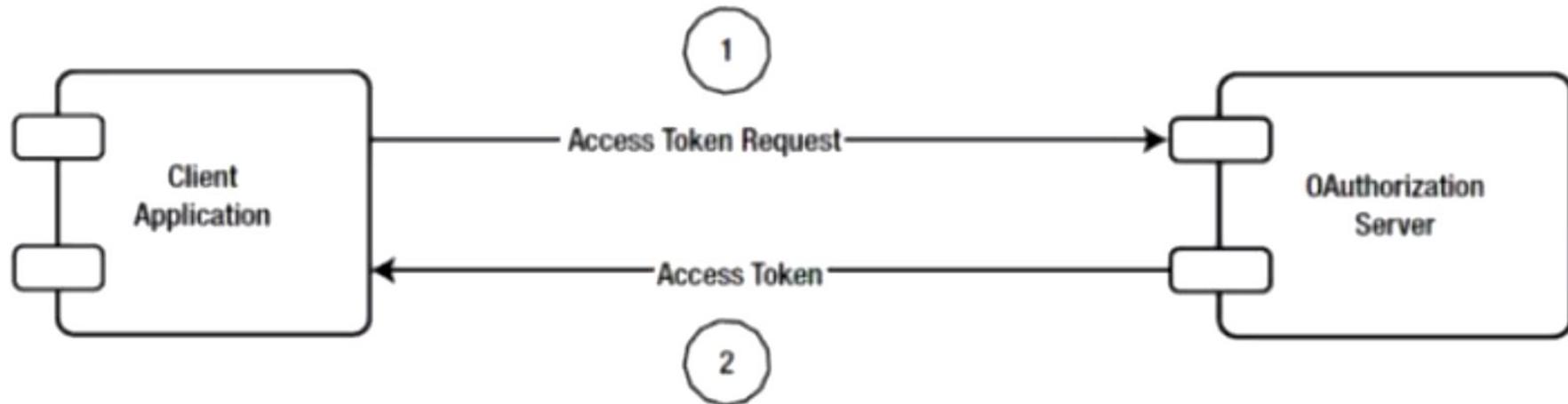
```
<handlers>
    <handler class="org.wso2.carbon.apimgt.gateway.handlers.common.APIMgtLatencyStatsHandler"/>
    <handler class="org.wso2.carbon.apimgt.gateway.handlers.security.CORSRequestHandler">
        <property name="apiImplementationType" value="ENDPOINT"/>
    </handler>
    <handler class="org.wso2.carbon.apimgt.gateway.handlers.security.APIAuthenticationHandler"/>
    <handler class="org.wso2.carbon.apimgt.gateway.handlers.throttling.ThrottleHandler"/>
    <handler class="org.wso2.carbon.apimgt.gateway.handlers.analytics.APIMgtUsageHandler"/>
    <handler class="org.wso2.carbon.apimgt.gateway.handlers.ext.APIManagerExtensionHandler"/>
</handlers>
```

API Security



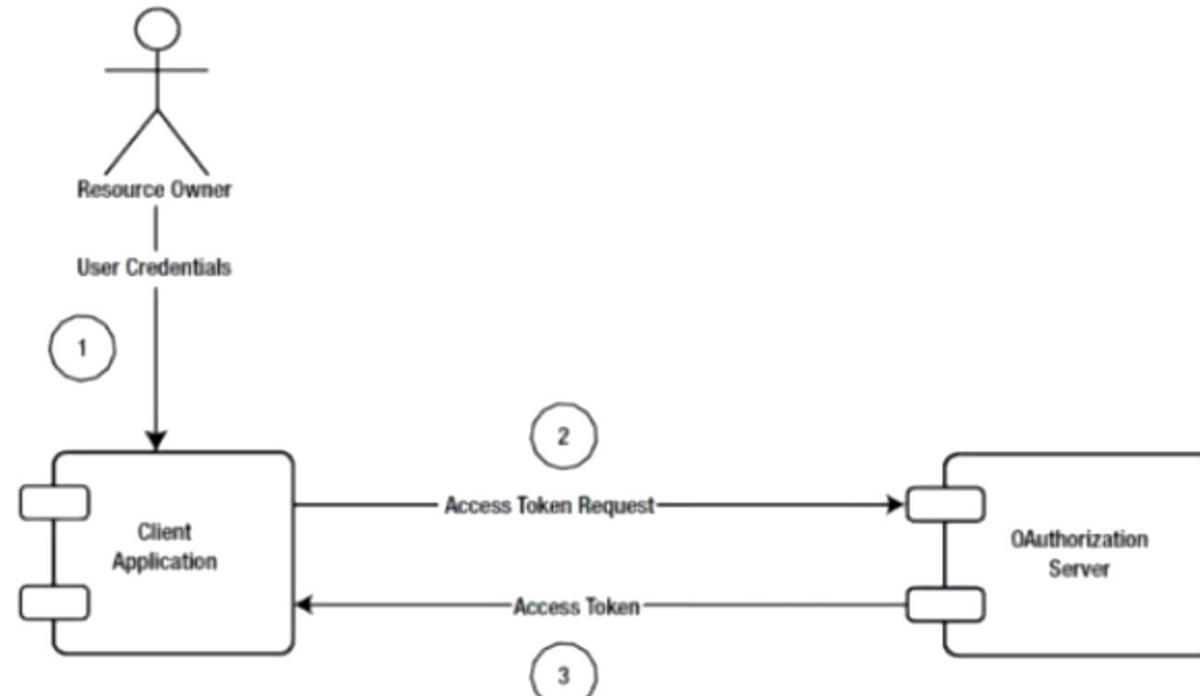
API Security

OAuth 2.0 Grants - Client Credentials



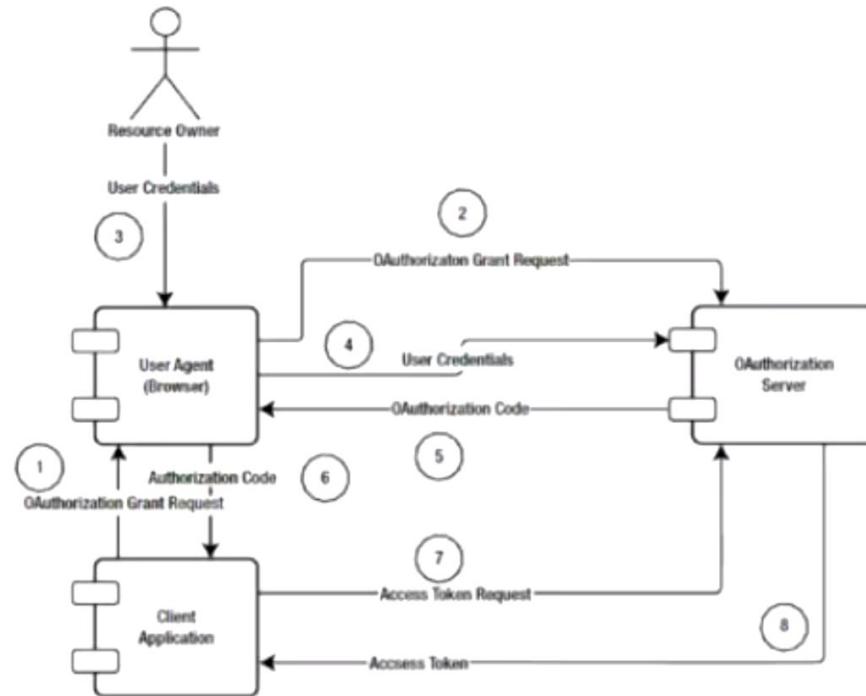
API Security

OAuth 2.0 Grants - Resource Owner Password



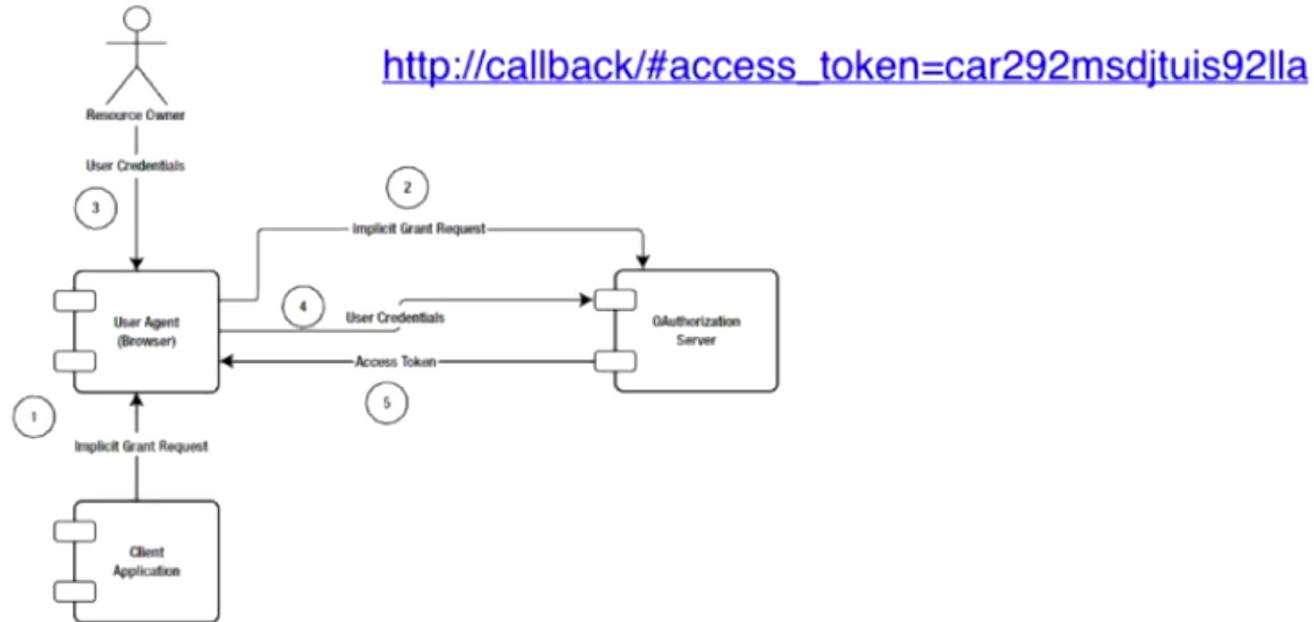
API Security

OAuth 2.0 Grants - Authorization Code

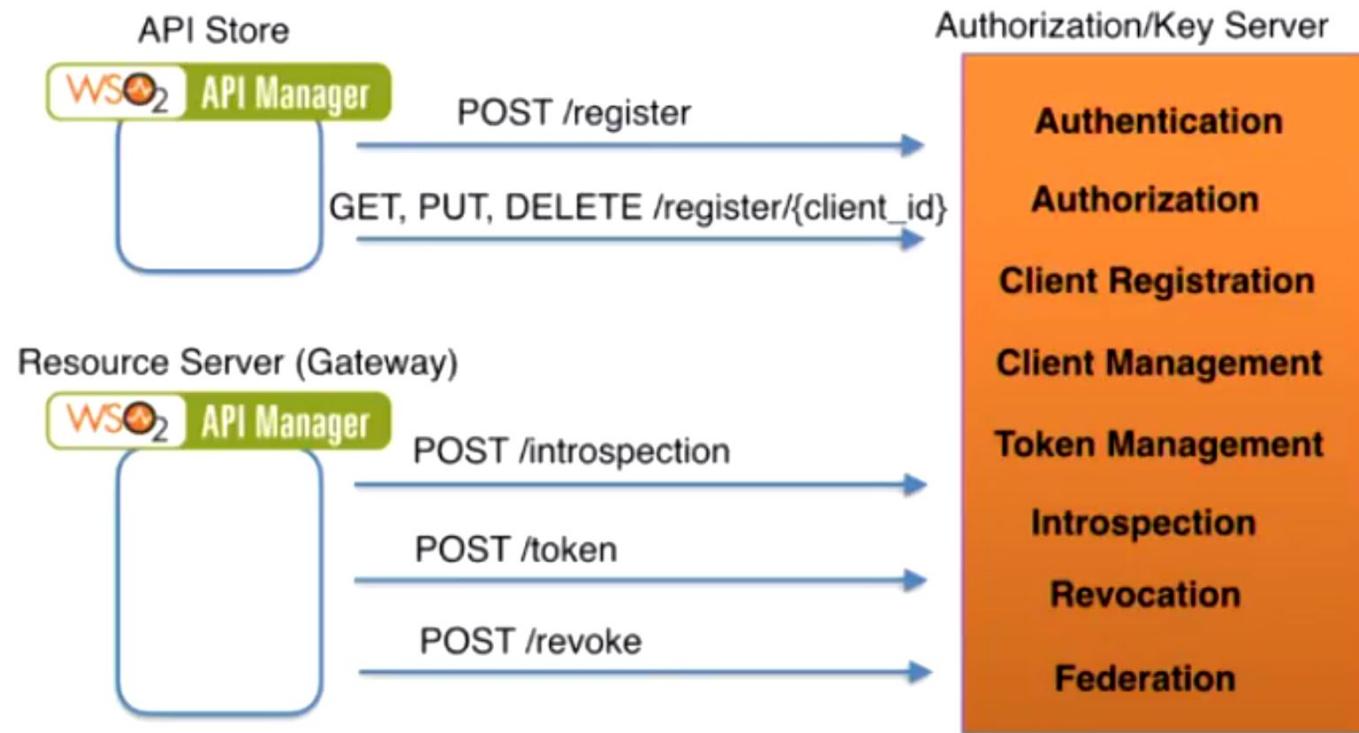


API Security

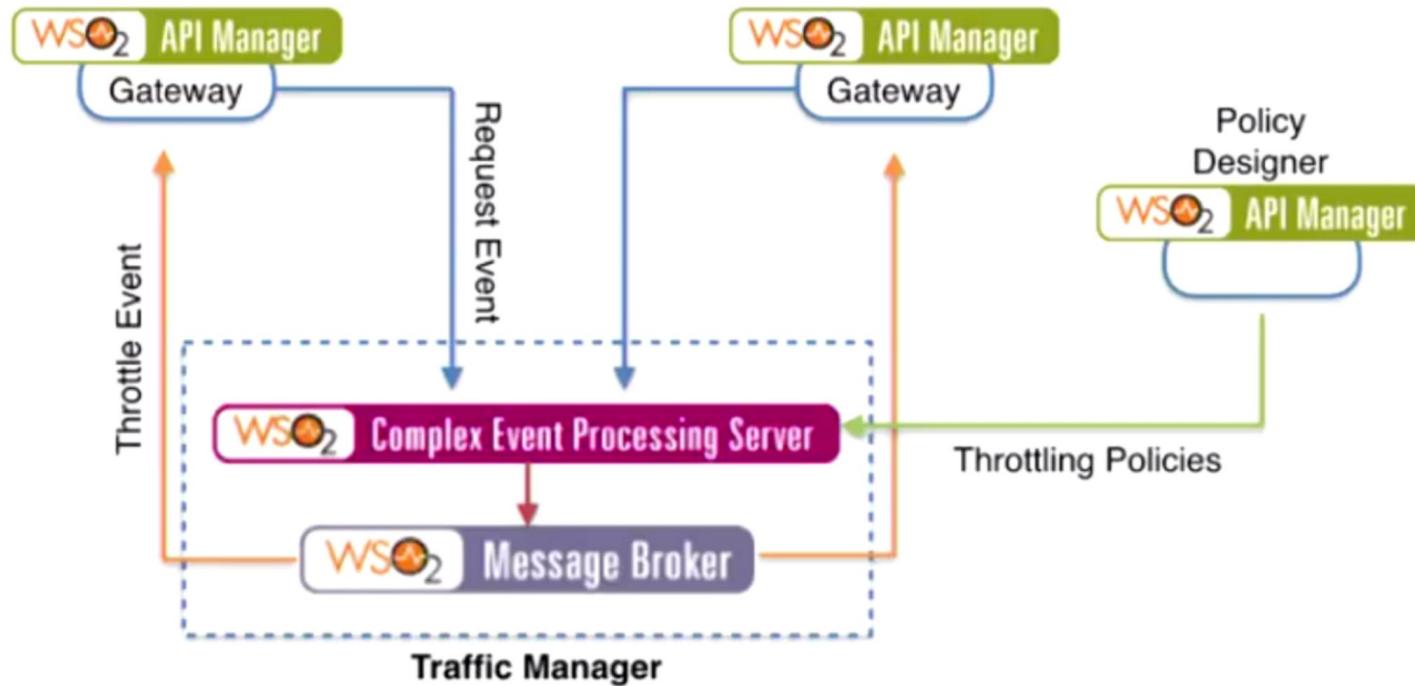
OAuth 2.0 Grants - Implicit



The Role of the Authorization/Key Server



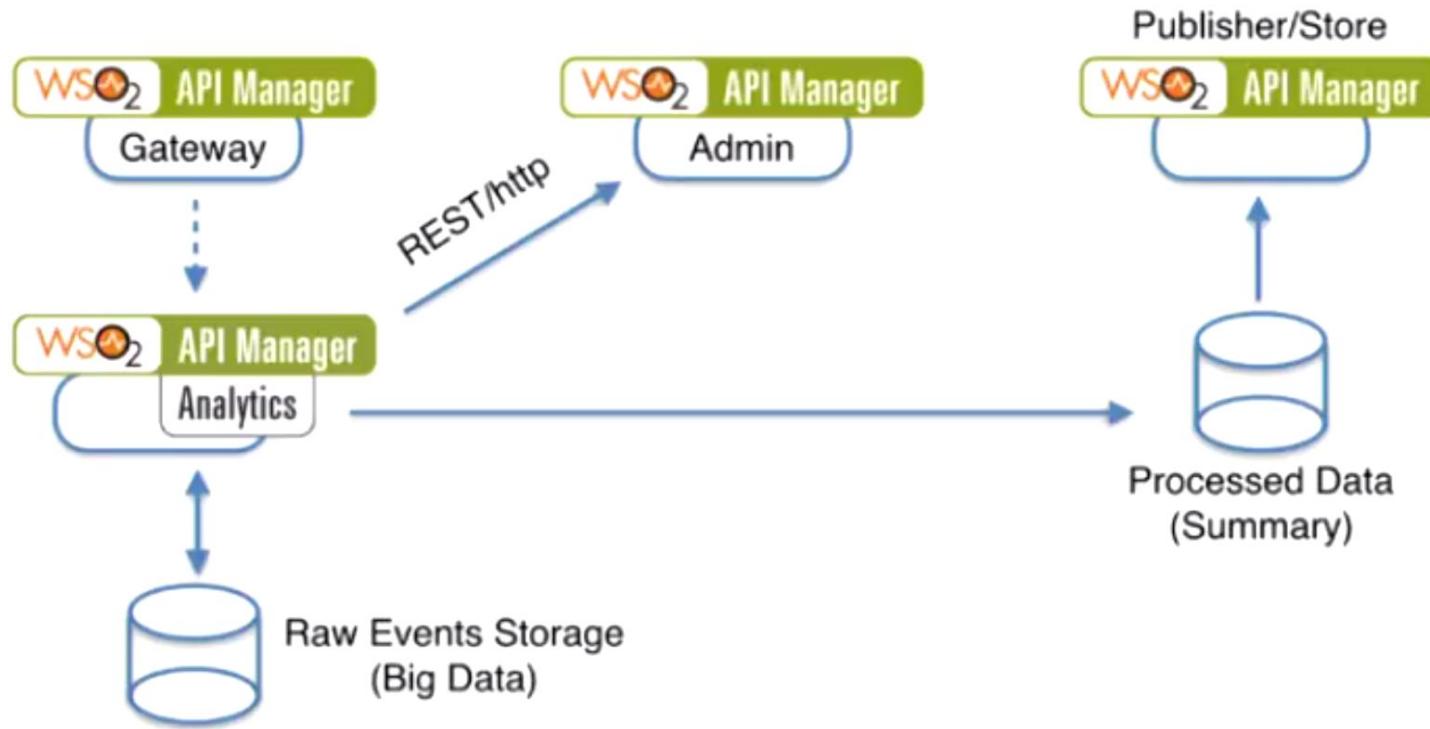
Traffic Management Architecture



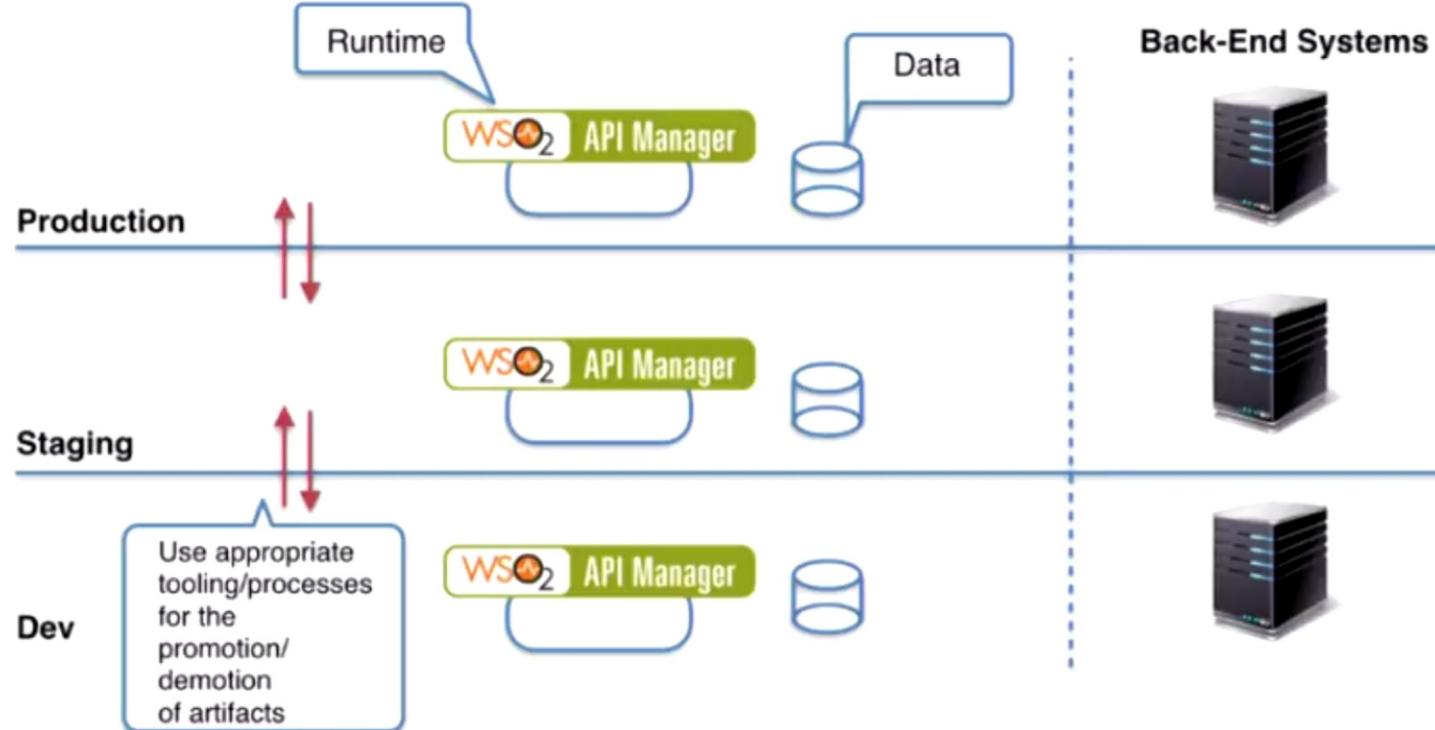
Traffic Manager Scalability

- The Traffic Manager does not scale
- A single Traffic Manager can handle up to 10 gateways at maximum capacity
- If a deployment consist of more than 10 gateways, the gateways should be divided into groups of clusters of 10 nodes each, having one Traffic Manager per group.

Analytics Architecture

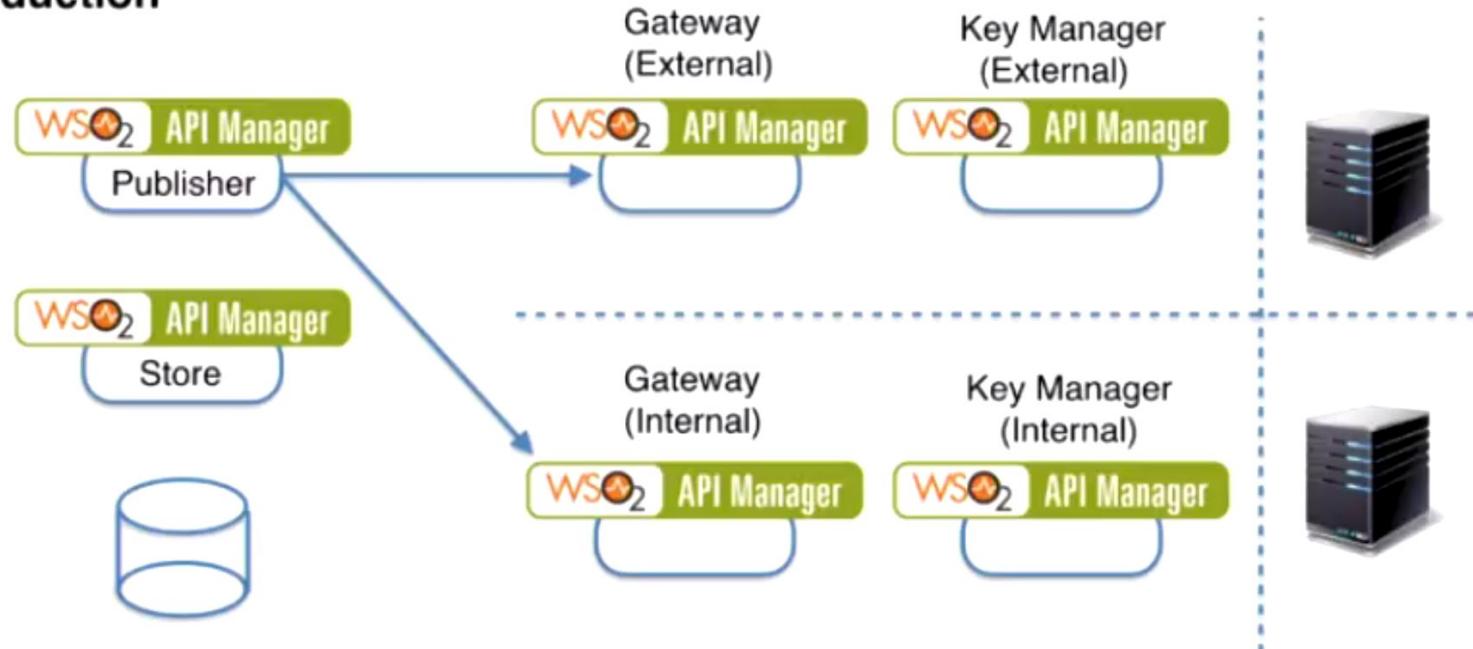


API: Stages vs Environments - Stages



API: Stages vs Environments - Environments

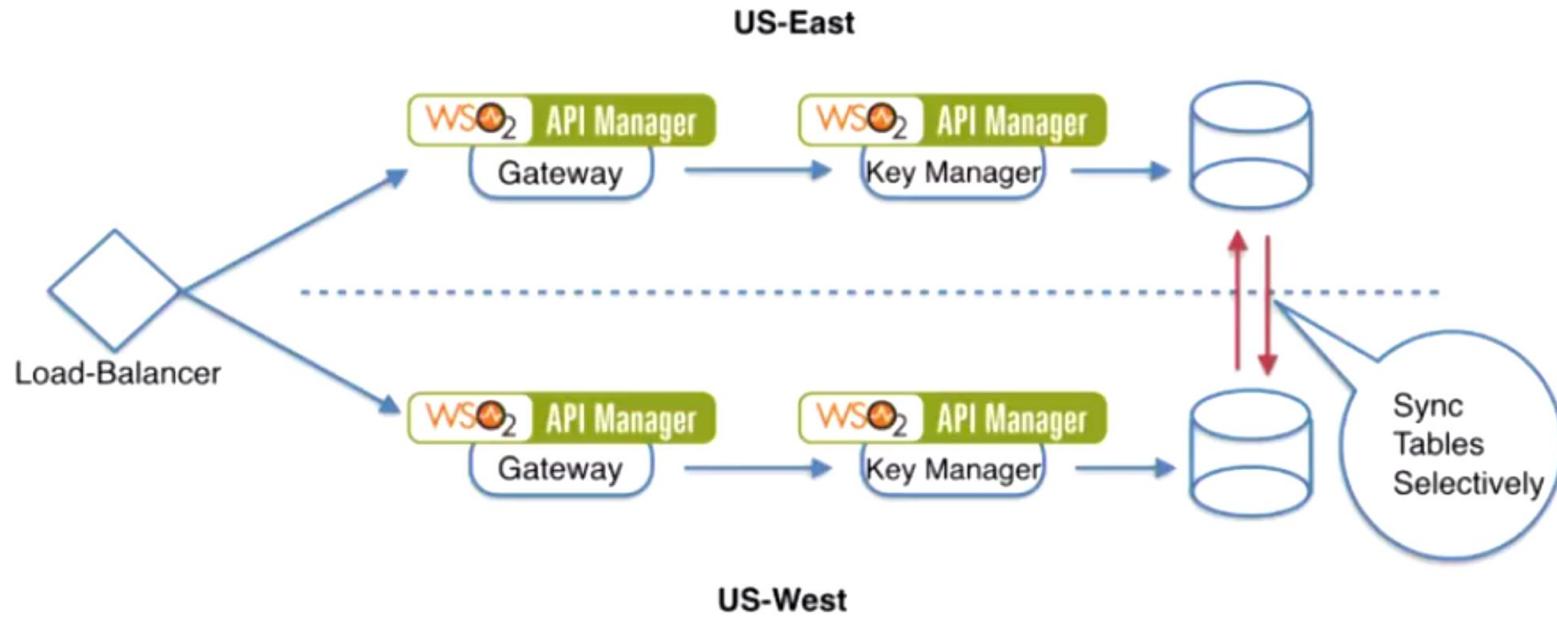
Production



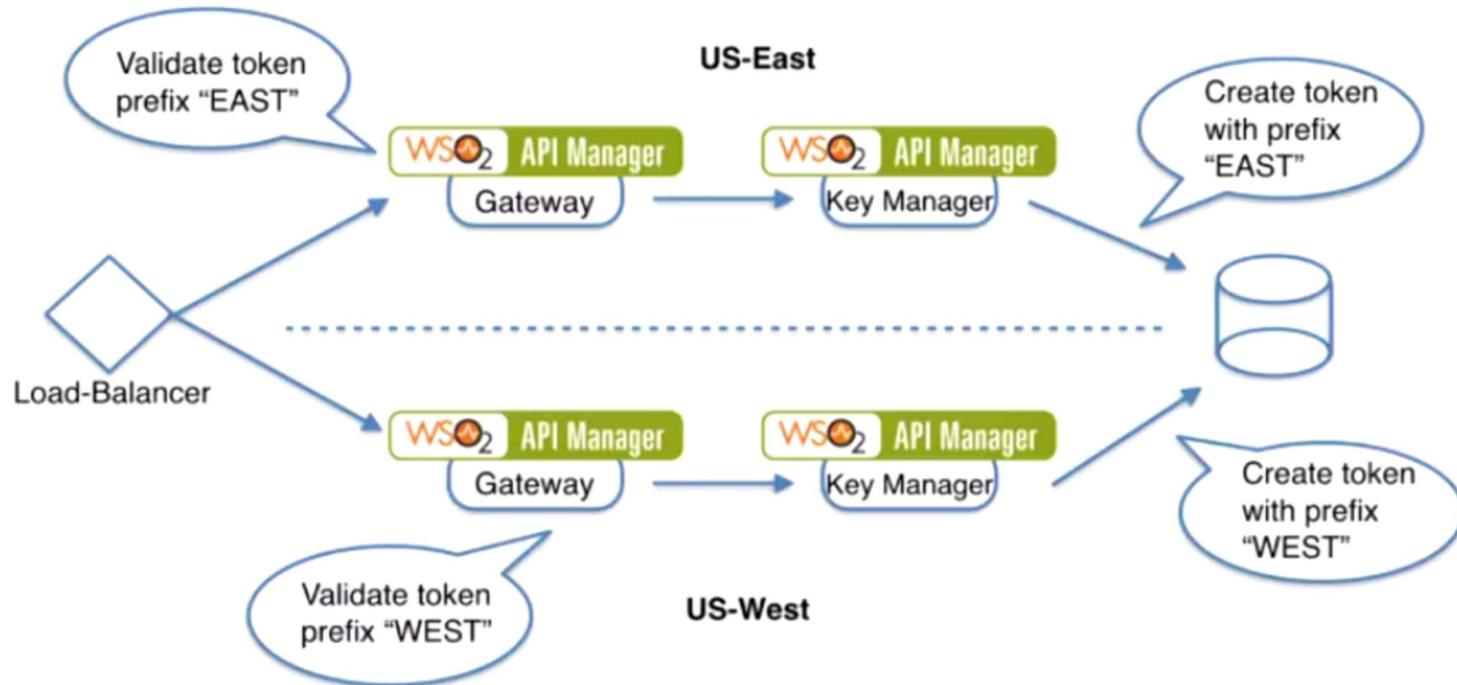
API: Stages vs Environments

Stage	Environment
Represents a state of an API	Represents the execution runtime of an API in a <u>given state</u>
An API may go through modifications when transferring between stages	The API Definition is fixed across environments
Shouldn't share data between stages	May share data across environments
Ownership of the API/data may change across stages	Ownership of the API/data remains same across all environments

Regional Gateways - Database Sync Pattern



Regional Gateways - Token Prefix Pattern



Regional Gateways - Token Prefix Pattern

```
public class CustomTokenGenerator extends OauthTokenIssuerImpl {  
  
    @Override  
    public String accessToken(OAuthTokenReqMessageContext tokReqMsgCtx) throws  
        OAuthSystemException {  
  
        String regionID = System.getProperty(REGION_ID);  
  
        if(log.isDebugEnabled()){  
            log.debug("Region ID = " + regionID);  
        }  
  
        String accessToken = UUID.randomUUID().toString();  
  
        return regionID != null ? regionID + accessToken : accessToken;  
    }  
}
```

Regional Gateways - Token Prefix Pattern

```
public class RegionValidator extends AbstractHandler {  
  
    public boolean handleRequest(MessageContext messageContext) {  
  
        String regionId = System.getProperty(REGION_ID);  
  
        if (log.isDebugEnabled()) {  
            log.debug("Region ID = " + regionId);  
        }  
  
        . . . . .  
  
        if(bearerToken == null || bearerToken.split(" ")[1].startsWith(regionId)){  
            //No bearer token provided or the provided bearer token is of the expected region.  
            return true;  
        }  
  
        handleAuthFailure(messageContext);  
  
        return false;  
    }  
}
```

WSO2 API Manager 2.1.0 Deployment Options

API Management: Deployment Options

On-Premise

- Fast!
- Tight security
- Complete control
- Limited to available infrastructure
- Need to handle updates and upgrades

API Management: Deployment Options

Cloud

- Can leverage cloud infrastructure
- No infrastructure costs
- No maintenance costs



WSO2 API Cloud

The screenshot shows the WSO2 API Management website with a dark background featuring a server rack graphic. The top navigation bar includes the WSO2 logo, a search bar, and links for DOWNLOAD and CONTACT US. Below the navigation, a horizontal menu bar offers OVERVIEW, CLOUD (which is highlighted in orange), FEATURES, CUSTOMER STORIES, and RESOURCES. The main content area features a large heading "API Cloud" and a descriptive paragraph about the service. A sign-up form is present, with an email input field containing "lakmal@wso2.com" and a "SIGN UP" button. A note below the form states that signing up signifies agreement to the Terms of Use and Privacy Policy. At the bottom, there is a link for users who already have an account and a "SIGN IN" button.

WSO2 API MANAGEMENT

OVERVIEW CLOUD FEATURES CUSTOMER STORIES RESOURCES

API Cloud

WSO2 API Cloud is a public hosted version of award-winning open source WSO2 API Manager. It enables enterprises to quickly share their business capabilities with their customers and partners across the globe.

API CLOUD

Free sign-up. No credit card required.

lakmal@wso2.com

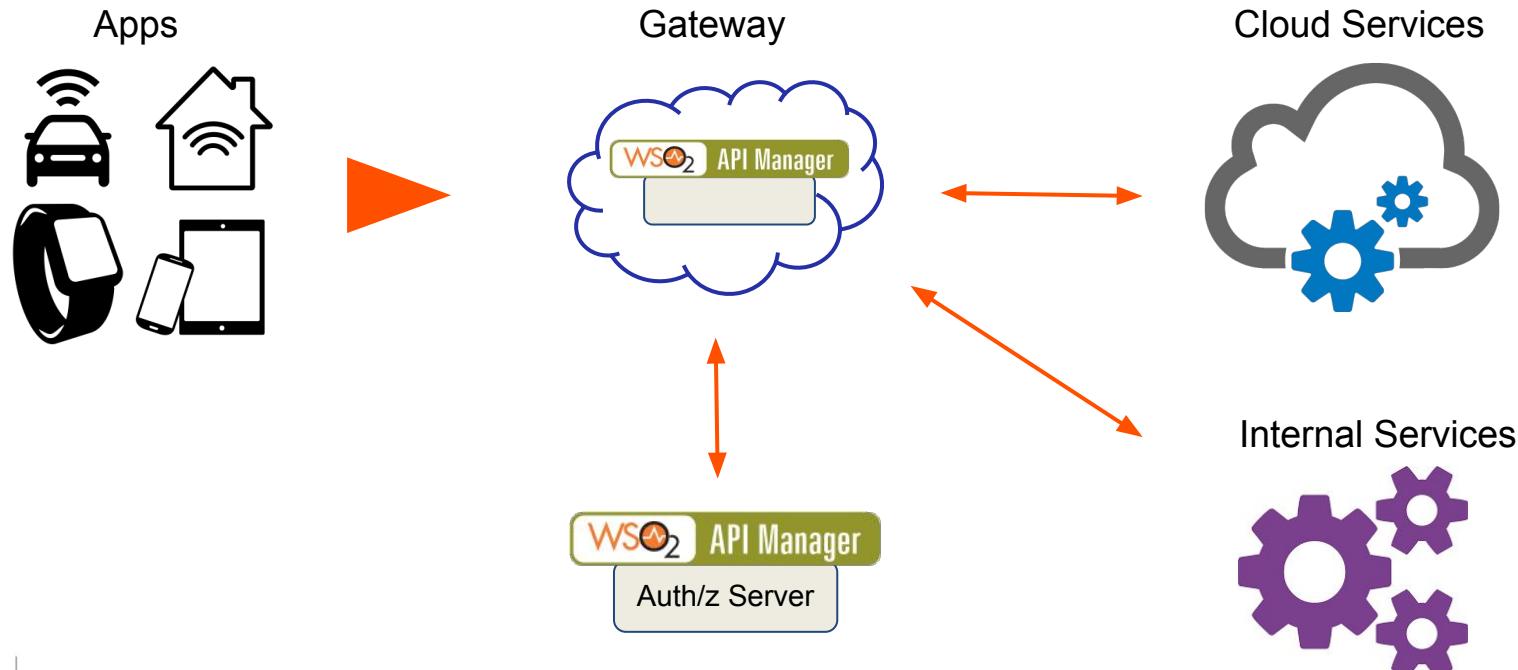
SIGN UP

Signing up signifies that you have read and agree to the [Terms of Use](#) and [Privacy Policy](#).

Already have an account? [SIGN IN](#)

API Management: Deployment Options

Hybrid Cloud



WSO2 API Manager 2.1.0 Deployment Patterns

Docker and Puppet

API Manager: Recommended Deployment Patterns

Pattern-1



- Docker : <https://github.com/wso2/docker-apim/tree/release-2.1.0/docker-compose/pattern-1>
- Puppet :
https://github.com/wso2/puppet-apim/blob/v2.1.0/wso2am_runtime/hieradata/dev/wso2/wso2am_runtime/pattern-1/README.md

API Manager: Recommended Deployment Patterns

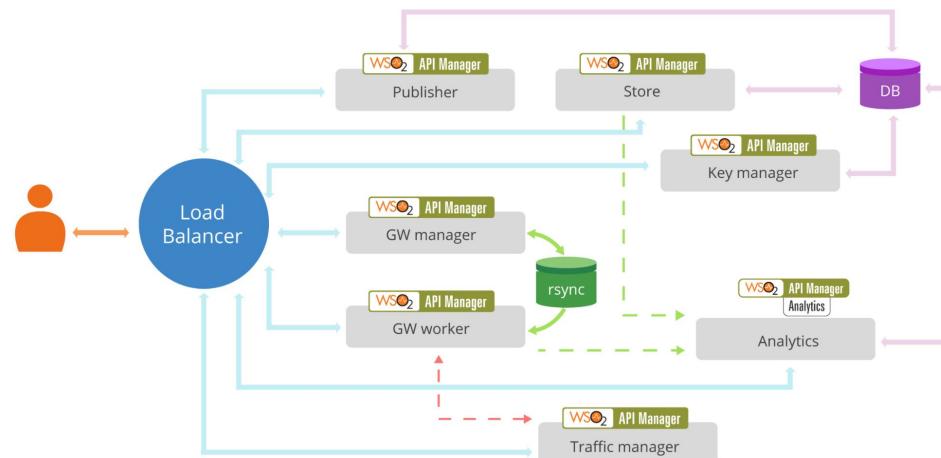
Pattern-2



- Docker : <https://github.com/wso2/docker-apim/tree/release-2.1.0/docker-compose/pattern-2>
- Puppet :
https://github.com/wso2/puppet-apim/blob/v2.1.0/wso2am_runtime/hieradata/dev/wso2/wso2am_runtime/pattern-2/README.md

API Manager: Recommended Deployment Patterns

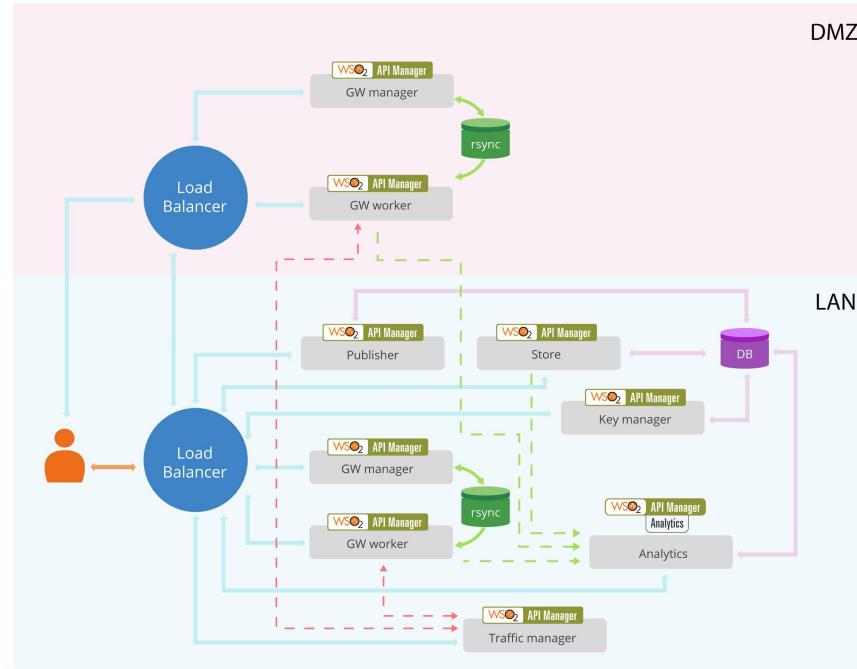
Pattern-3



- Docker : <https://github.com/wso2/docker-apim/tree/release-2.1.0/docker-compose/pattern-3>
- Puppet :
https://github.com/wso2/puppet-apim/blob/v2.1.0/wso2am_runtime/hieradata/dev/wso2/wso2am_runtime/pattern-3/README.md

API Manager: Recommended Deployment Patterns

Pattern-4



- **Docker :**

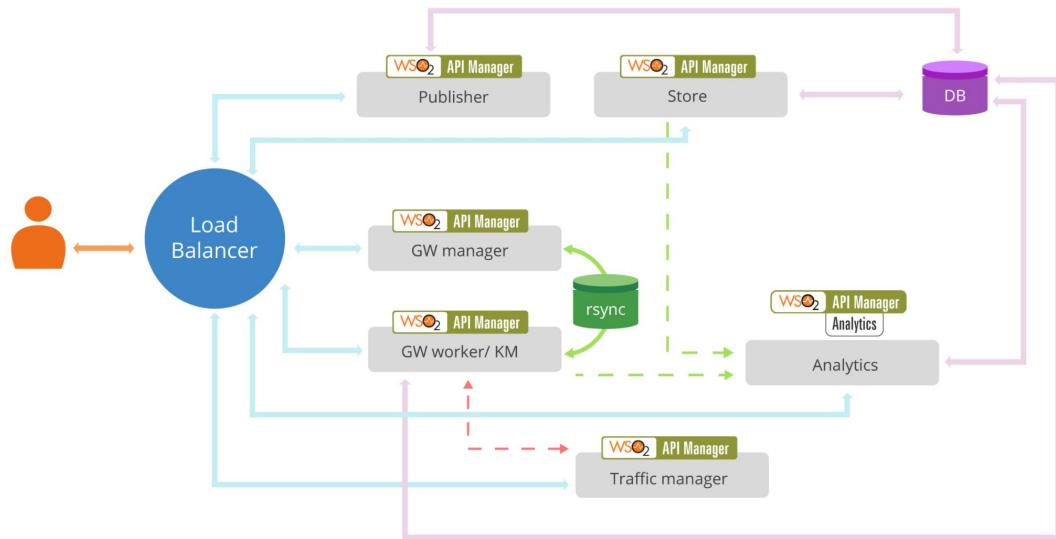
[https://github.com/wso2/docker-apim/tree/
release-2.1.0/docker-compose/pattern-4](https://github.com/wso2/docker-apim/tree/release-2.1.0/docker-compose/pattern-4)

- **Puppet :**

[https://github.com/wso2/puppet-apim/blob/
v2.1.0/wso2am_runtime/hieradata/dev/wso2am_runtime/pattern-4/README.md](https://github.com/wso2/puppet-apim/blob/v2.1.0/wso2am_runtime/hieradata/dev/wso2/wso2am_runtime/pattern-4/README.md)

API Manager: Recommended Deployment Patterns

Pattern-5



- **Docker :**

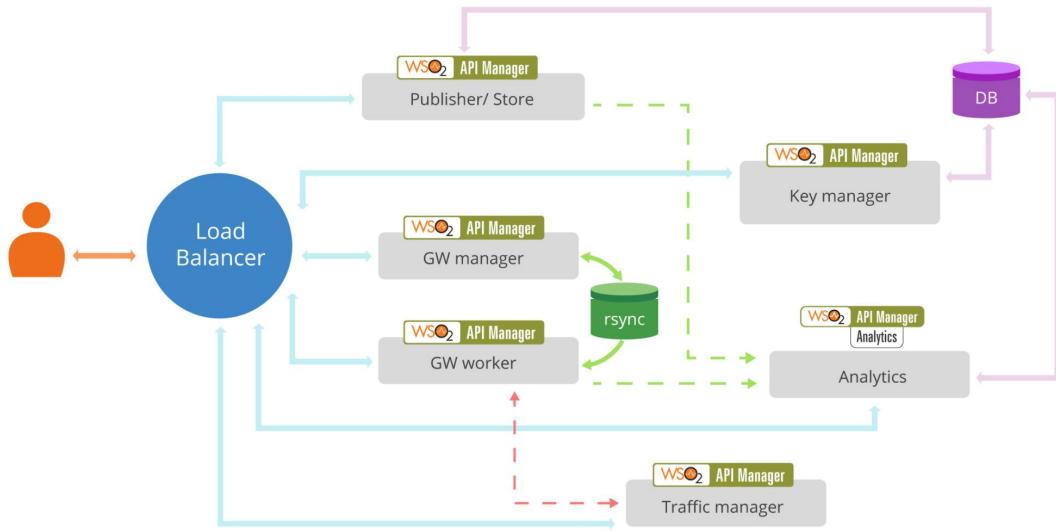
[https://github.com/wso2/docker-apim/tree/
release-2.1.0/docker-compose/pattern-5](https://github.com/wso2/docker-apim/tree/release-2.1.0/docker-compose/pattern-5)

- **Puppet :**

[https://github.com/wso2/puppet-apim/blob/
v2.1.0/wso2am_runtime/hieradata/dev/wso2/wso2am_runtime/pattern-5/README.md](https://github.com/wso2/puppet-apim/blob/v2.1.0/wso2am_runtime/hieradata/dev/wso2/wso2am_runtime/pattern-5/README.md)

API Manager: Recommended Deployment Patterns

Pattern-6



- **Docker :**

[https://github.com/wso2/docker-apim/tree/
release-2.1.0/docker-compose/pattern-6](https://github.com/wso2/docker-apim/tree/release-2.1.0/docker-compose/pattern-6)

- **Puppet :**

[https://github.com/wso2/puppet-apim/blob/
v2.1.0/wso2am_runtime/hieradata/dev/wso2/wso2am_runtime/pattern-6/README.md](https://github.com/wso2/puppet-apim/blob/v2.1.0/wso2am_runtime/hieradata/dev/wso2/wso2am_runtime/pattern-6/README.md)

API Manager: Recommended Deployment Patterns

Pattern-7



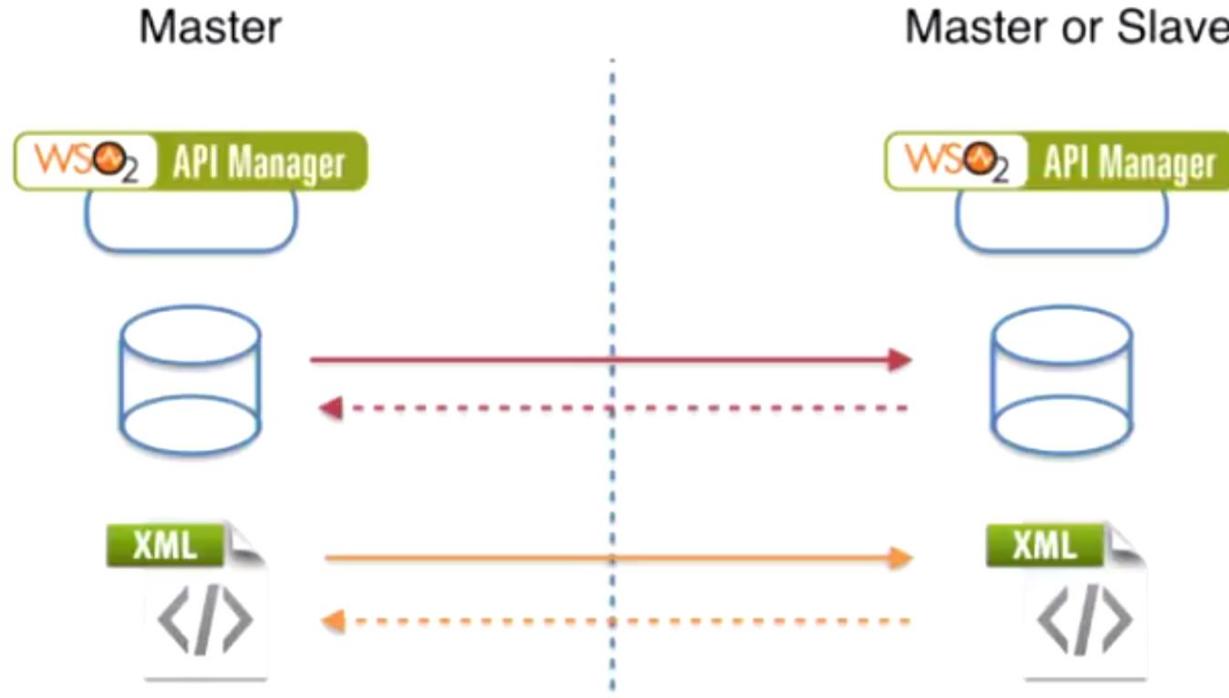
- Docker : <https://github.com/wso2/docker-apim/tree/release-2.1.0/docker-compose/pattern-7>
- Puppet :
https://github.com/wso2/puppet-apim/blob/v2.1.0/wso2am_runtime/hieradata/dev/wso2/wso2am_runtime/pattern-7/README.md

API Manager: Multi Datacenter Deployment

Types of Datacenter Deployment

- Single Master, Active-Active
- Single Master, Active-Passive (Disaster Recovery)
- Multi Master, Active-Active

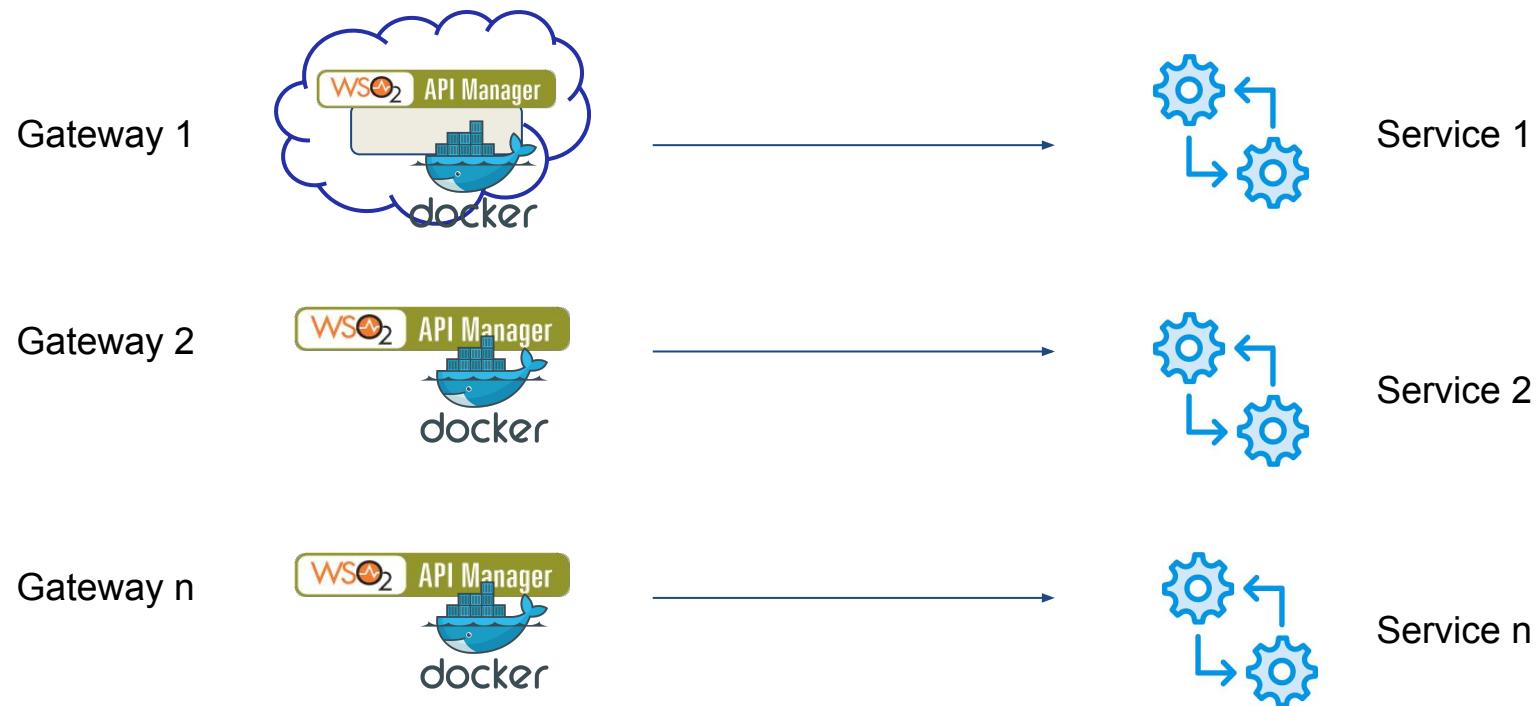
API Manager: Multi Datacenter Deployment



WSO2 API Manager 3.0.0

Highlights

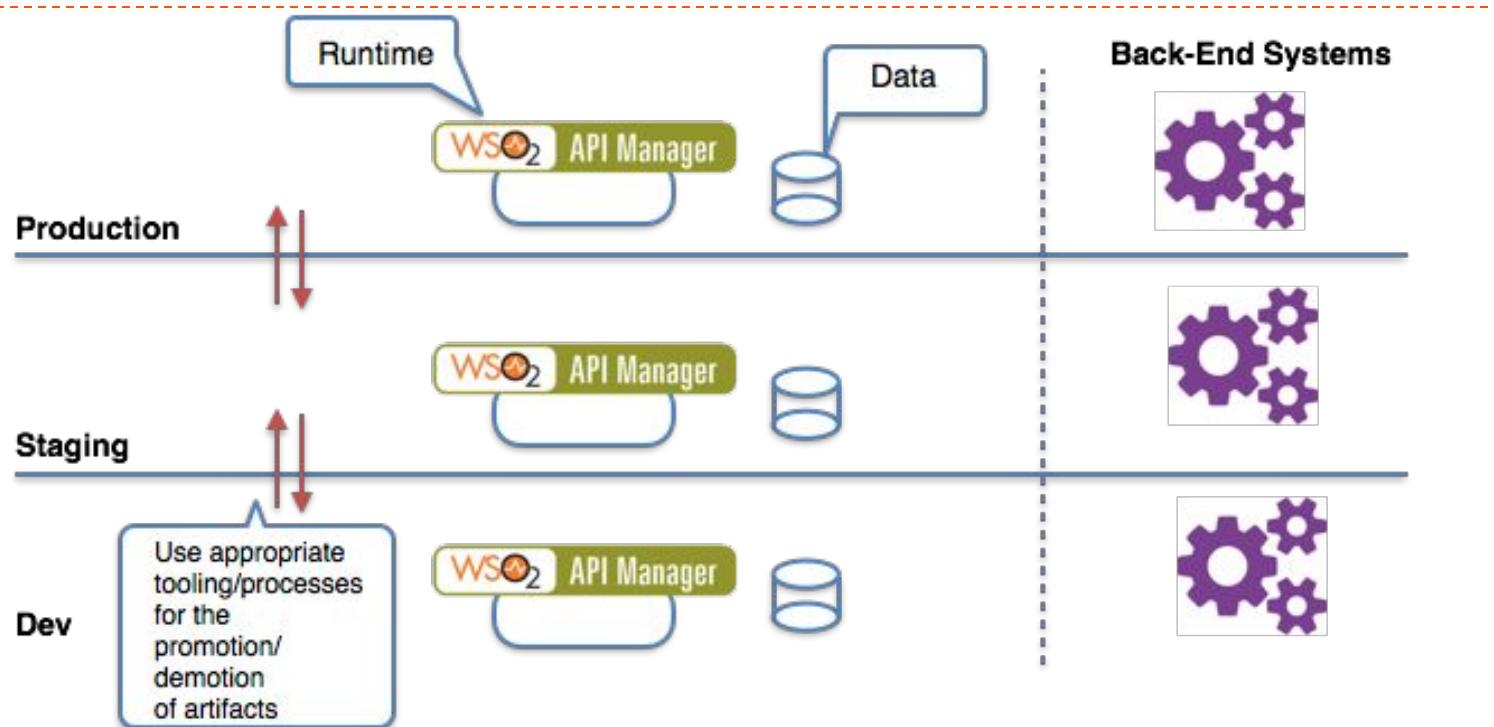
Micro Gateways: For Micro Services



The API Proxy Development Experience

- Tooling
- Testing (Enhanced)
- Collaboration
- API Stages

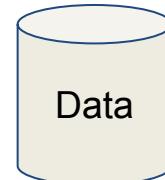
Stages of the API Proxy



Multitenancy: Shared



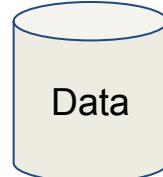
Runtime



Multitenancy: Shared



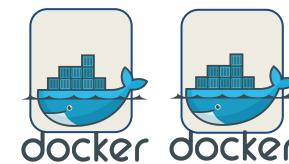
Runtime



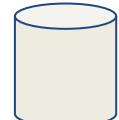
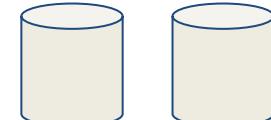
Multitenancy: Isolated



Runtime



Data



How to Digitize your Business APIs

Demo

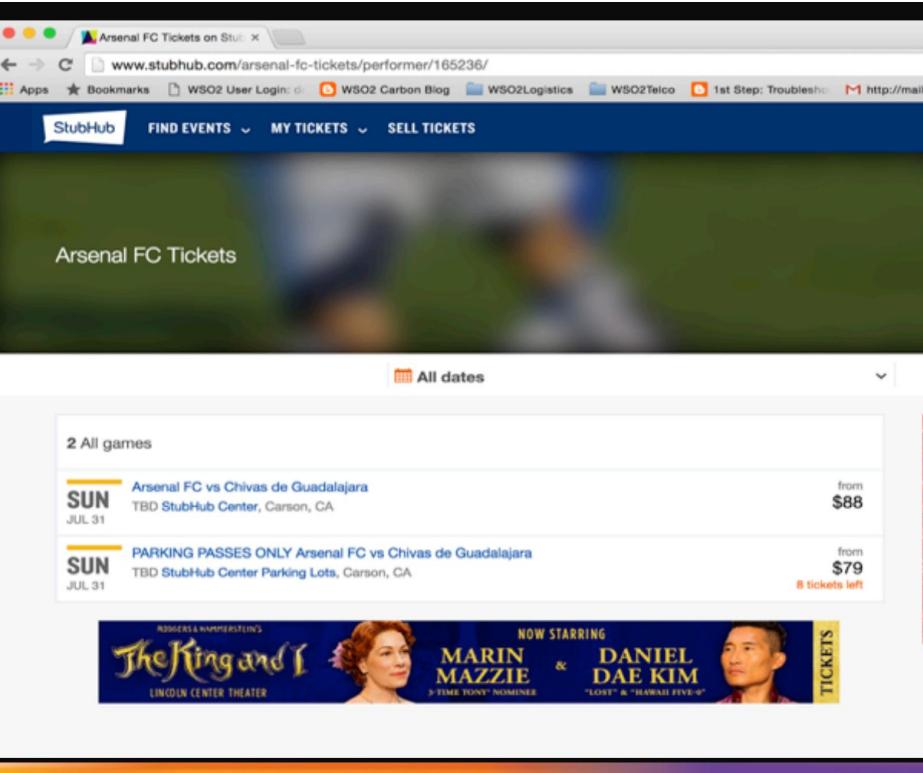
How to digitize your business APIs

Demo

- [Create and Publish an API](#)
- [Subscribe to an API](#)
- [Add API Documentation](#)
- [Grant types](#)
- Federation - Facebook login
- Throttling
- Analytics
- Docker compose based deployments

API-Centric Digital Transformation Success Stories

API-Centric Digital Transformation Success Stories

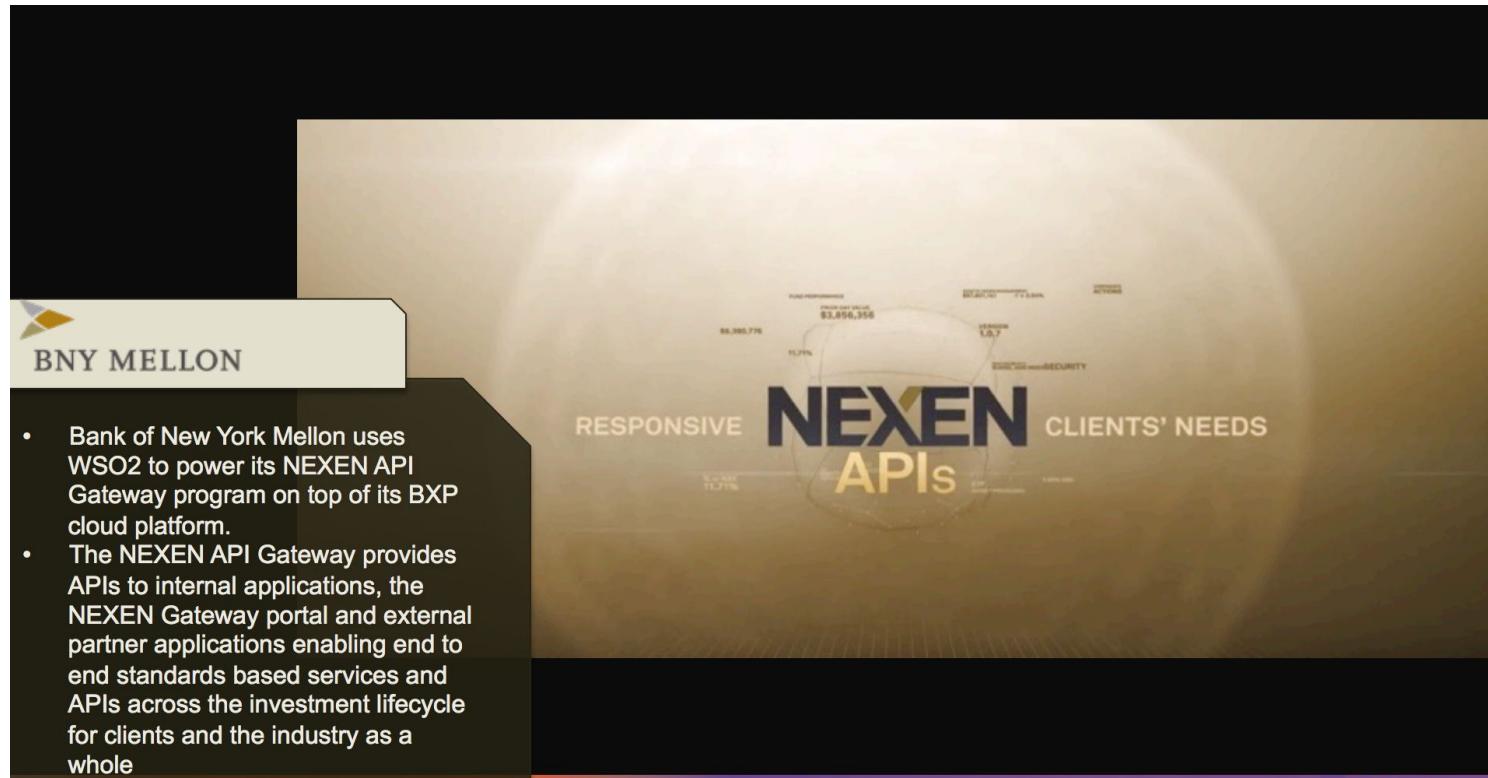


The screenshot shows a web browser displaying the StubHub website for Arsenal FC Tickets. The page features a large banner image of a football player in action. Below the banner, there's a search bar and navigation links for 'FIND EVENTS', 'MY TICKETS', and 'SELL TICKETS'. A sidebar on the left lists '2 All games' for 'Arsenal FC vs Chivas de Guadalajara' on 'SUN JUL 31' at 'TBD StubHub Center, Carson, CA' with a price of 'from \$88'. Another listing for 'PARKING PASSES ONLY' is also shown. At the bottom of the page, there's a promotional banner for 'The King and I' at Lincoln Center Theater.

• Stubhub, an eBay company, manages an event marketplace facilitating global ticket sales

• Stubhub hosts a globally distributed API Management platform based on WSO2 API Manager that serves internal applications and external partner applications

API-Centric Digital Transformation Success Stories



The image shows a digital advertisement for BNY Mellon's NEXEN APIs. On the left, there is a white callout box containing the BNY Mellon logo and a bulleted list of success stories. The main background features a large, stylized globe with various data points and the text "RESPONSIVE", "NEXEN APIs", and "CLIENTS' NEEDS".

BNY MELLON

- Bank of New York Mellon uses WSO2 to power its NEXEN API Gateway program on top of its BXP cloud platform.
- The NEXEN API Gateway provides APIs to internal applications, the NEXEN Gateway portal and external partner applications enabling end to end standards based services and APIs across the investment lifecycle for clients and the industry as a whole

RESPONSIVE **NEXEN** APIs CLIENTS' NEEDS

WSO2 | 82

API-Centric Digital Transformation Success Stories

Over 250 enterprises use our comprehensive platform globally. More than 25 are Global 2000 companies.



Conclusion

Digital Transformation is a Journey, APIs play a critical part in it!

API MANAGEMENT

Build your digital foundation with an API marketplace for internal and external developer ecosystems

[LEARN MORE](#)

INTEGRATION

Platform enable your digital business with "micro-services" and "micro-integrations"

[LEARN MORE](#)

IDENTITY & ACCESS MANAGEMENT

Manage identity, security, and privacy across your digital business

[LEARN MORE](#)

SMART ANALYTICS

Create real-time, intelligent, actionable business insights and data products

[LEARN MORE](#)

INTERNET OF THINGS

Make mobile and IoT devices integral to your digital business

[LEARN MORE](#)

THANK YOU

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