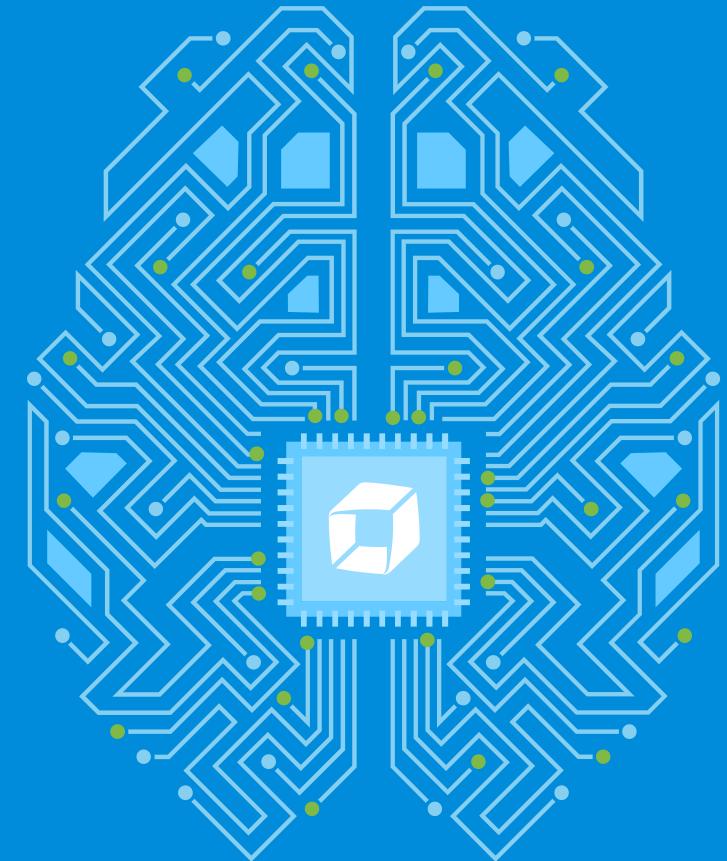




인공지능 APM을 이용한 OpenStack 모니터링



디지털 성능 관리 분야 7년 연속 세계 1위 Dynatrace



August 2016

Worldwide Distributed Application Performance Management Software Revenue by Vendor, 2013-2015 (\$M)

	2013	2014	2015	2015 Share (%)	2014-2015 Growth (%)
Dynatrace	324.3	338.1	378.8	14.6	12.0
HPE					
IBM					
CA Technologies	#1				
Microsoft					
New Relic	1	1	0	Dynatrace*	271.0 326.9 376.6 12.7 13.3 13.9 20.6 15.2
Riverbed	3	2	1	IBM	192.3 219.2 226.6 9.0 8.9 8.3 14.0 3.4
AppDynamics	2	3	-1	CA Technologies	194.1 220.6 198.9 9.1 9.0 7.3 13.6 -9.8
Splunk	8	4	4	New Relic	56.5 96.8 162.6 2.6 3.9 6.0 71.3 68.0
Dell	4	5	-1	HPE**	173.1 177.0 153.6 8.1 7.2 5.7 2.3 -13.2
Other	10	6	4	AppDynamics	22.8 77.2 143.8 1.1 3.1 5.3 238.6 86.3
Total	5	7	-2	Microsoft	112.7 134.2 139.2 5.3 5.5 5.1 19.1 3.7
	6	8	-2	Riverbed	112.6 119.7 128.8 5.3 4.9 4.7 6.3 7.6
	7	9	-2	Splunk	80.6 102.8 117.9 3.8 4.2 4.3 27.5 14.7
	9	10	-1	Oracle	79.3 83.8 77.9 3.7 3.4 2.9 5.6 -7.0
	-	-	-	Others	840.3 898.0 992.0 39.4 36.6 36.5 6.9 10.4
				Total	2,135.3 2,456.3 2,717.6 100.0 100.0 100.0 15.0 10.6

Source: IDC, August 2016

Table 3. Top 10 Named APM Vendors Ranked by 2015 Revenue, 2013-2015 (Millions of Dollars)

Rank 2014	Rank 2015	Rank Change	Vendor	Revenue 2013	Revenue 2014	Revenue 2015	Share (%) 2013	Share (%) 2014	Share (%) 2015	Growth (%) 2014	Growth (%) 2015
			Dynatrace*	271.0	326.9	376.6	12.7	13.3	13.9	20.6	15.2
			IBM	192.3	219.2	226.6	9.0	8.9	8.3	14.0	3.4
			CA Technologies	194.1	220.6	198.9	9.1	9.0	7.3	13.6	-9.8
			New Relic	56.5	96.8	162.6	2.6	3.9	6.0	71.3	68.0
			HPE**	173.1	177.0	153.6	8.1	7.2	5.7	2.3	-13.2
			AppDynamics	22.8	77.2	143.8	1.1	3.1	5.3	238.6	86.3
			Microsoft	112.7	134.2	139.2	5.3	5.5	5.1	19.1	3.7
			Riverbed	112.6	119.7	128.8	5.3	4.9	4.7	6.3	7.6
			Splunk	80.6	102.8	117.9	3.8	4.2	4.3	27.5	14.7
			Oracle	79.3	83.8	77.9	3.7	3.4	2.9	5.6	-7.0
			Others	840.3	898.0	992.0	39.4	36.6	36.5	6.9	10.4
			Total	2,135.3	2,456.3	2,717.6	100.0	100.0	100.0	15.0	10.6

* 2013 through 2015 revenue, share and growth is for Compuware and Dynatrace and also for Keynote Systems, which merged with Dynatrace in 4Q15.

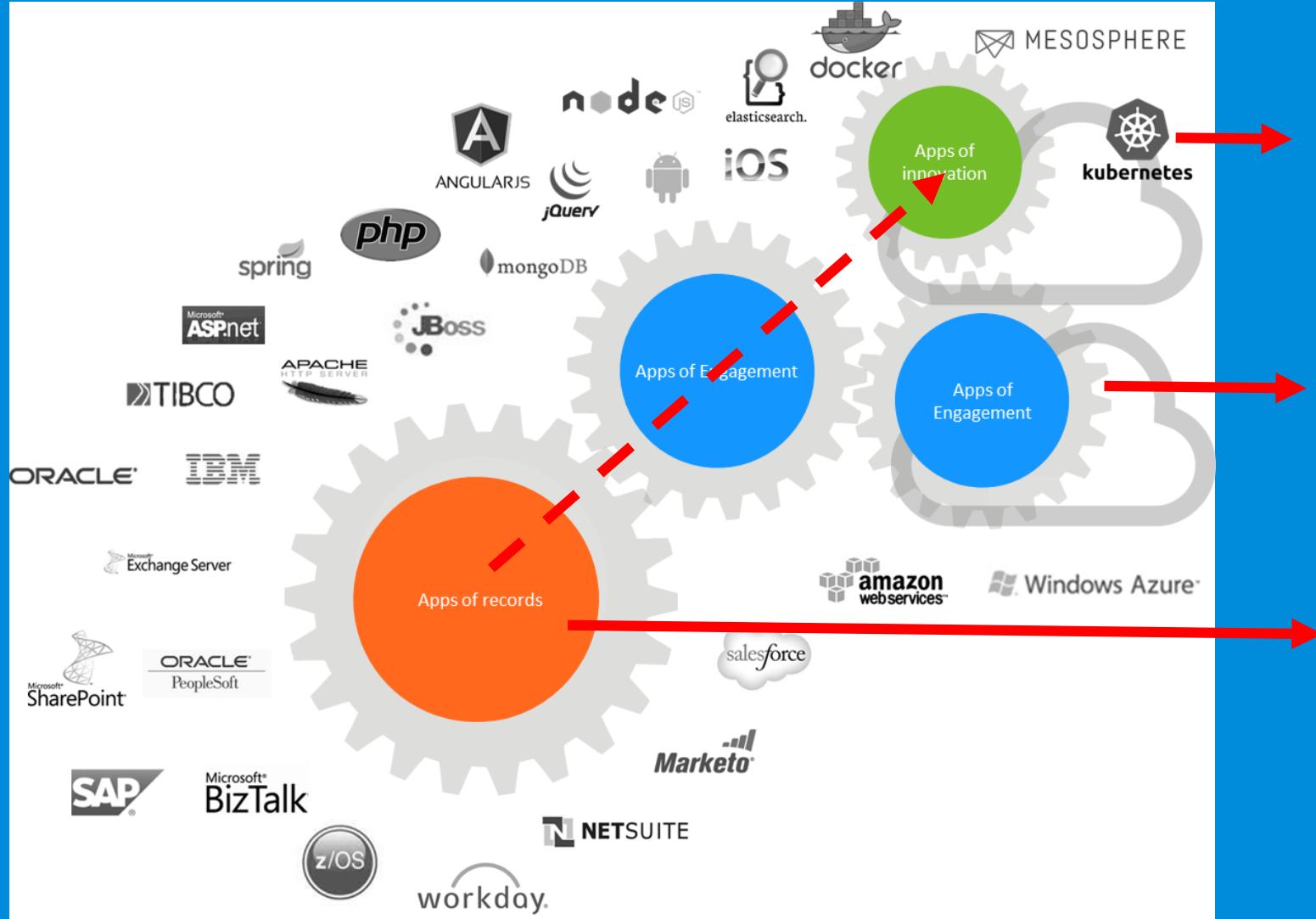
Gartner

Figure 1. Magic Quadrant for Application Performance Monitoring Suites



Source: Gartner (December 2016)

기업의 IT 환경 변화 – Multimodal



OpenStack, OpenShift, CloudFoundry, AWS, Azure, Bluemix, Microservice 등으로 구성된 Cloud 환경

Web, Java, .Net 등으로 구성된 분산 환경

Legacy Systems: SAP, Oracle Forms, Mainframe 등 폐쇄형 환경

All-In-One Monitoring



Digital Experience Analytics

- Mobile app monitoring
- Real-user monitoring
- Synthetic monitoring
- IoT device monitoring
- Business transaction monitoring



Application Performance Monitoring

- Deep dive app monitoring
- Database monitoring
- Mainframe monitoring
- Enterprise app monitoring
- Continuous delivery & devops



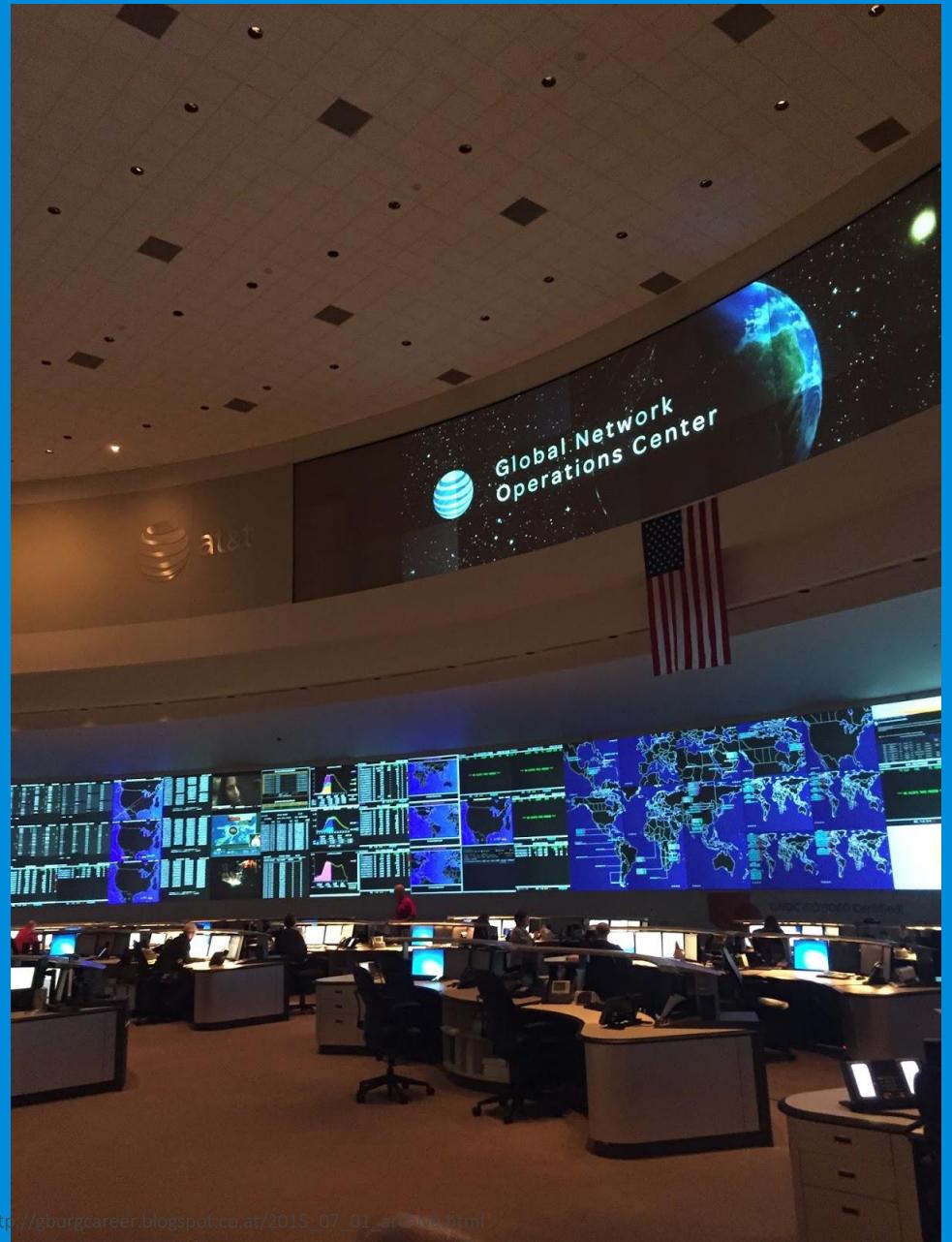
Cloud and Infrastructure Monitoring

- Cloud monitoring
- Microservice & container monitoring
- Infrastructure monitoring
- Log analytics & management
- Network monitoring

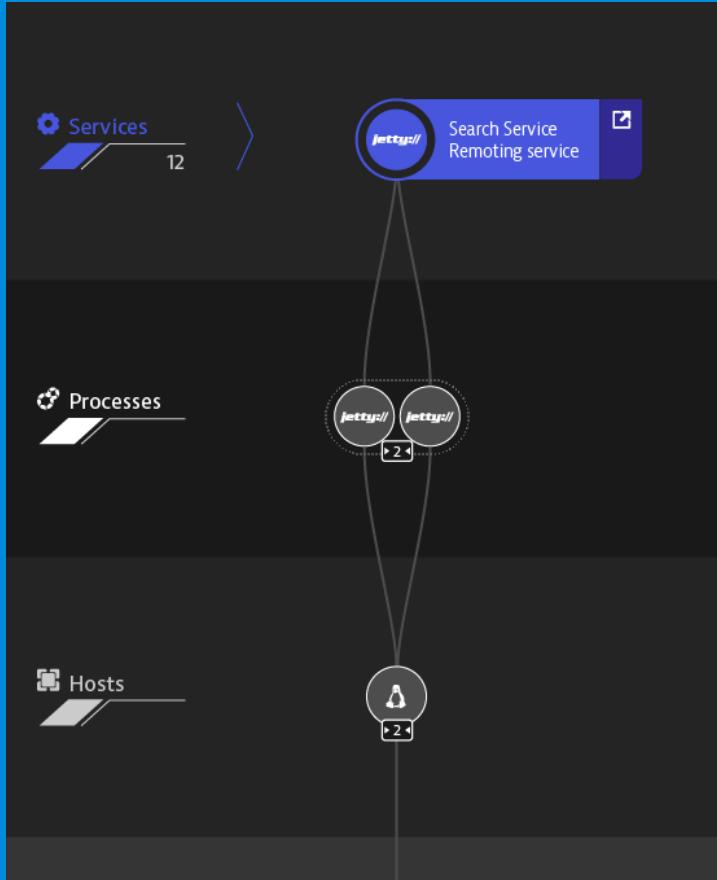
Global delivery & expert services

모니터링 과제!

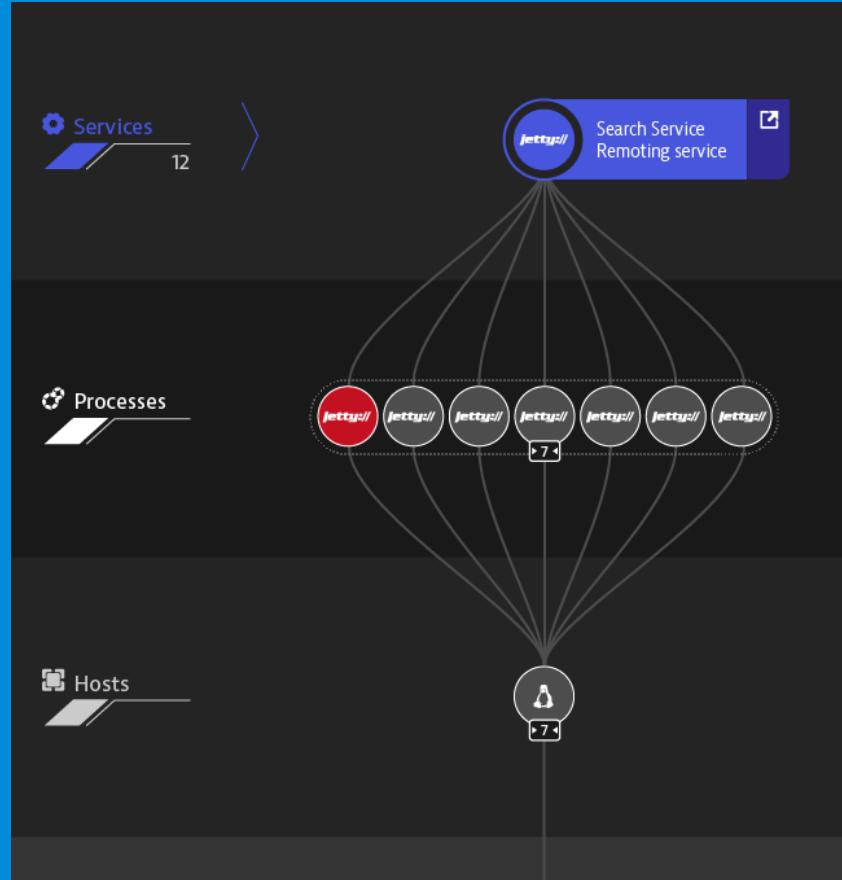
- VM, Process, container, service, User 까지 모니터링 파편화!
 - ✓ OpenStack == micro service application
 - ✓ 서로 다른 agent, 수집 방법 관리?
- 동적 환경(Dynamic environments)
 - ✓ 대규모 환경 (Large scale)
- 문제 감지 및 원인분석의 어려움 (Troubleshooting is hard)
 - ✓ Infra? Process? Container? Network? Response Time? Availability? Log?
 - ✓ 어떻게 연결되어 있지? ...



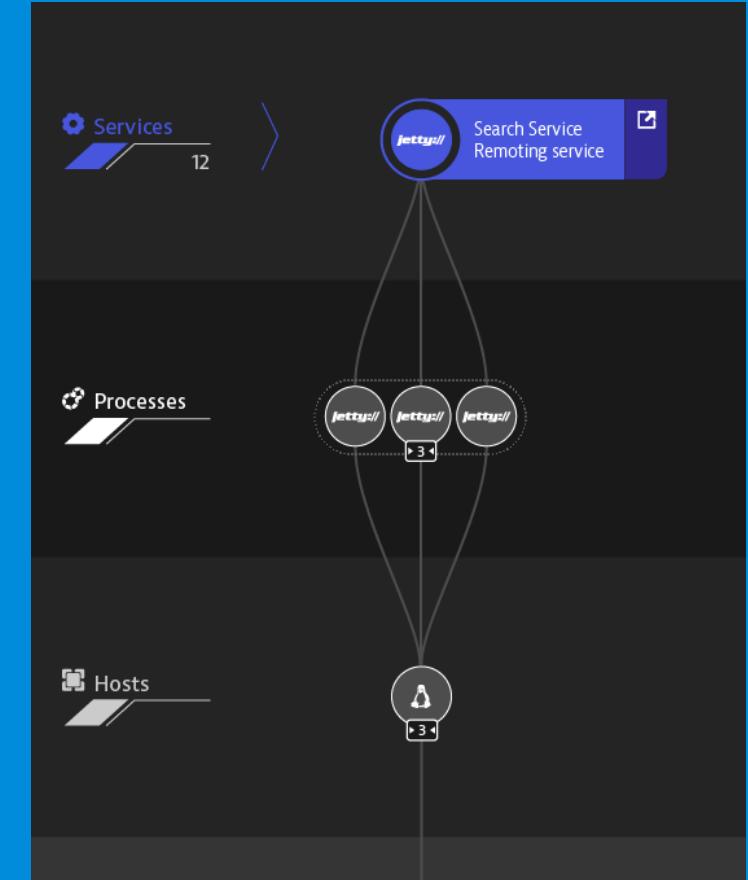
이제는 Dynamic 구성 관리 필요!



7:00 a.m.
Low Load and Service running on
minimum redundancy

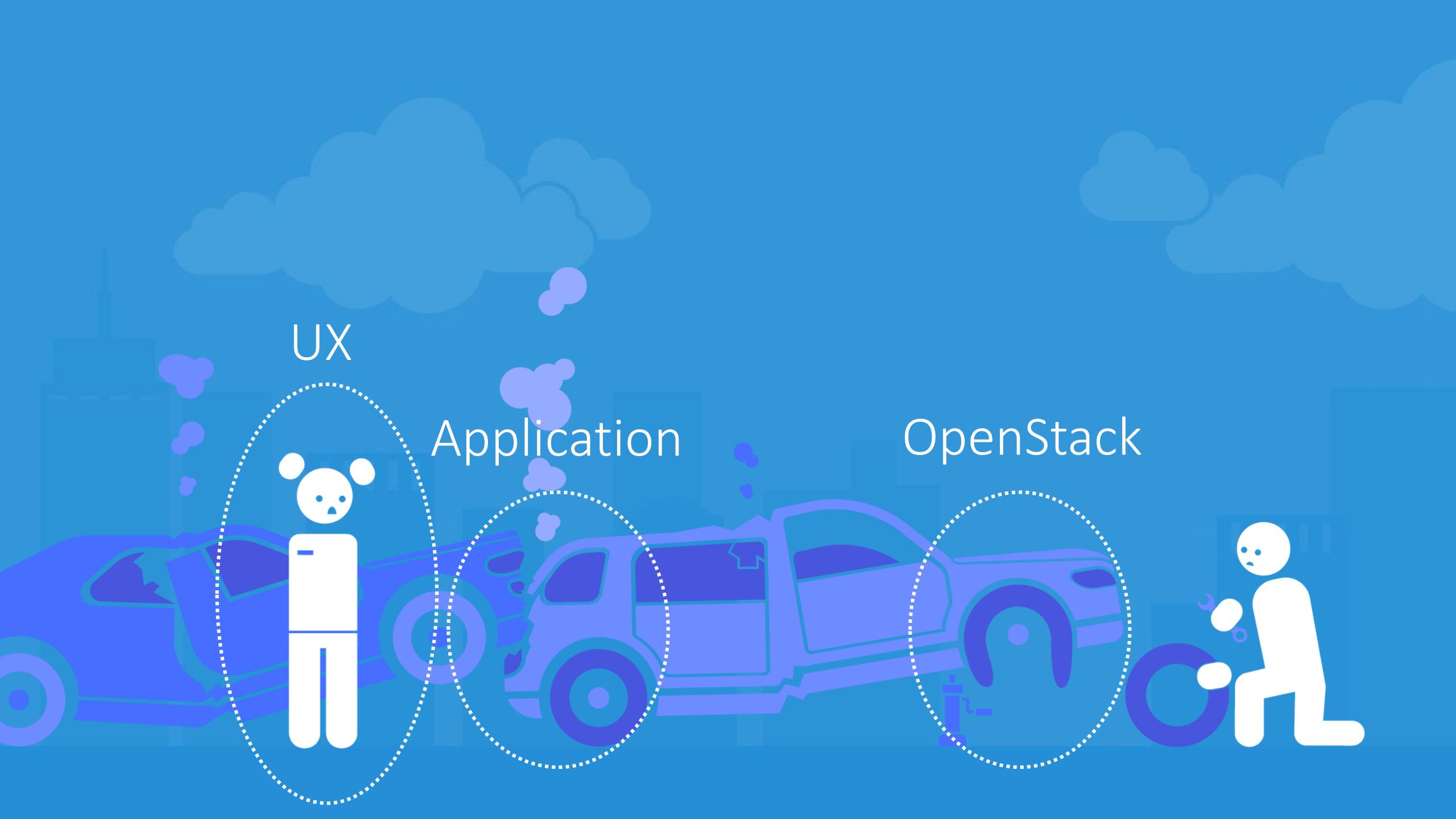


12:00 a.m.
Scaled up service during peak load with
failover of problematic node



7:00 p.m.
Scaled down again to lower load
and move to different geo location

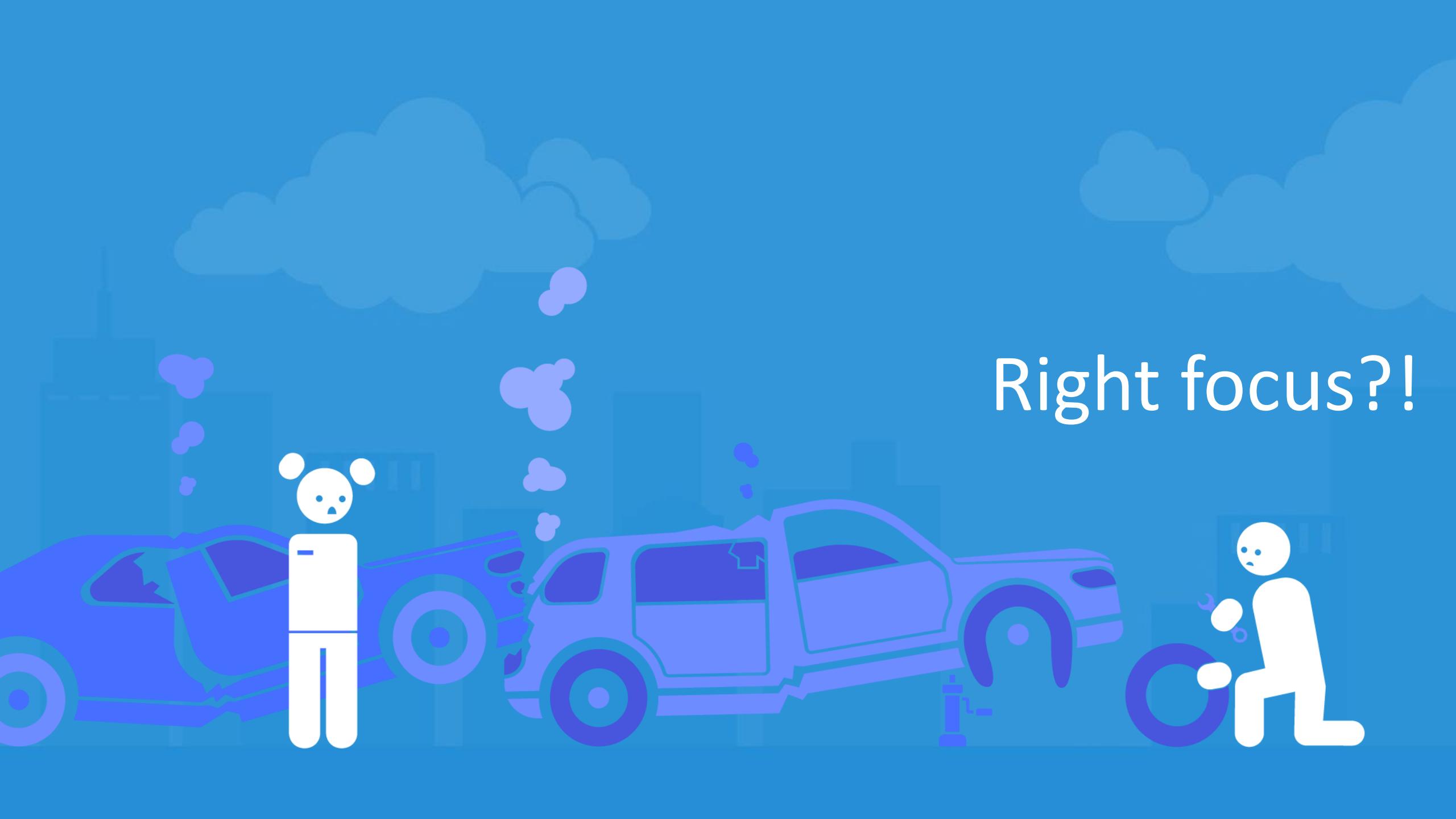




UX

Application

OpenStack



Right focus?!

우리 쪽 문제가 아니야~~

Application



OpenStack



Dynatrace – 업계 최초 Unrivalled Features



Artificial
Intelligent

Big Data
Fully Automated

One
Agent

UX /
IoT Ready

Virtual
Assistant

Flexible Deployment



SaaS - Cloud



Managed - On
Premise



Response time degradation

www.easytravel.com

Applications

Services

Infrastructure components

This is a problem that is affecting real users.



Response time degradation

www.easytravel.vmware.com

Problem 350

Since 09:14

Duration 21 m

Impacted applications

- www.easytravel.vmware.com

Impact

- 29.8 user actions/min affected
- location North America
- user action click on "Login" on page /orange.jsf

Root cause

- AuthenticationService (vmware) - Response time degradation



106,253,420

Dependencies analyzed

Affected	Recovered	Monitored
-	1	2
-	4	32
-	-	269

Impact on real users

8 User actions per minute impacted

www.easytravel.com

Application

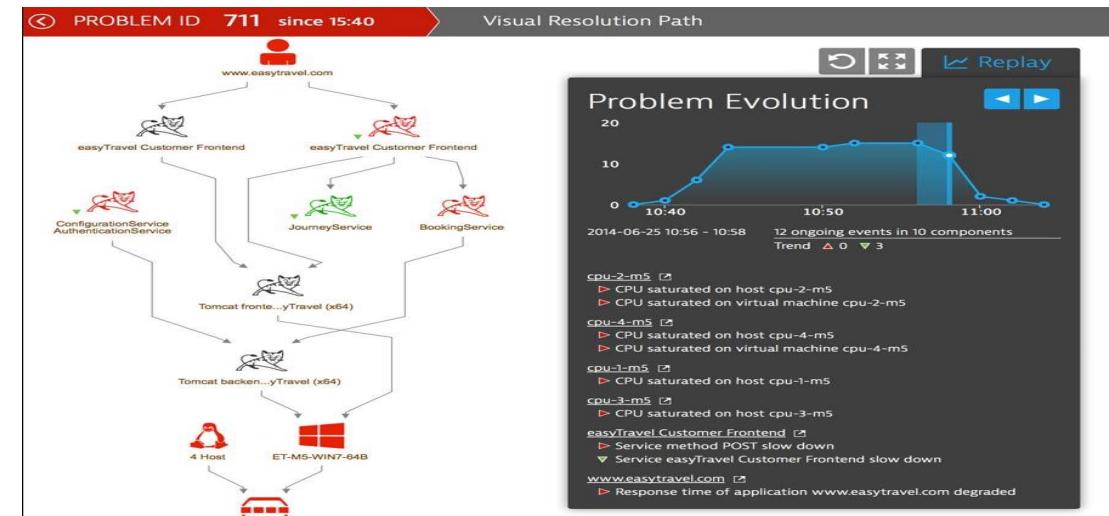
Response time degradation ✓8 /min
User actions

Browser Bandwidth

All All

Geolocation OS

North America All



10M+ events/sec

문제 감지 및 영향도 파악

A
I

인공지능

 Applications

9

 Services

30/3304

 Processes

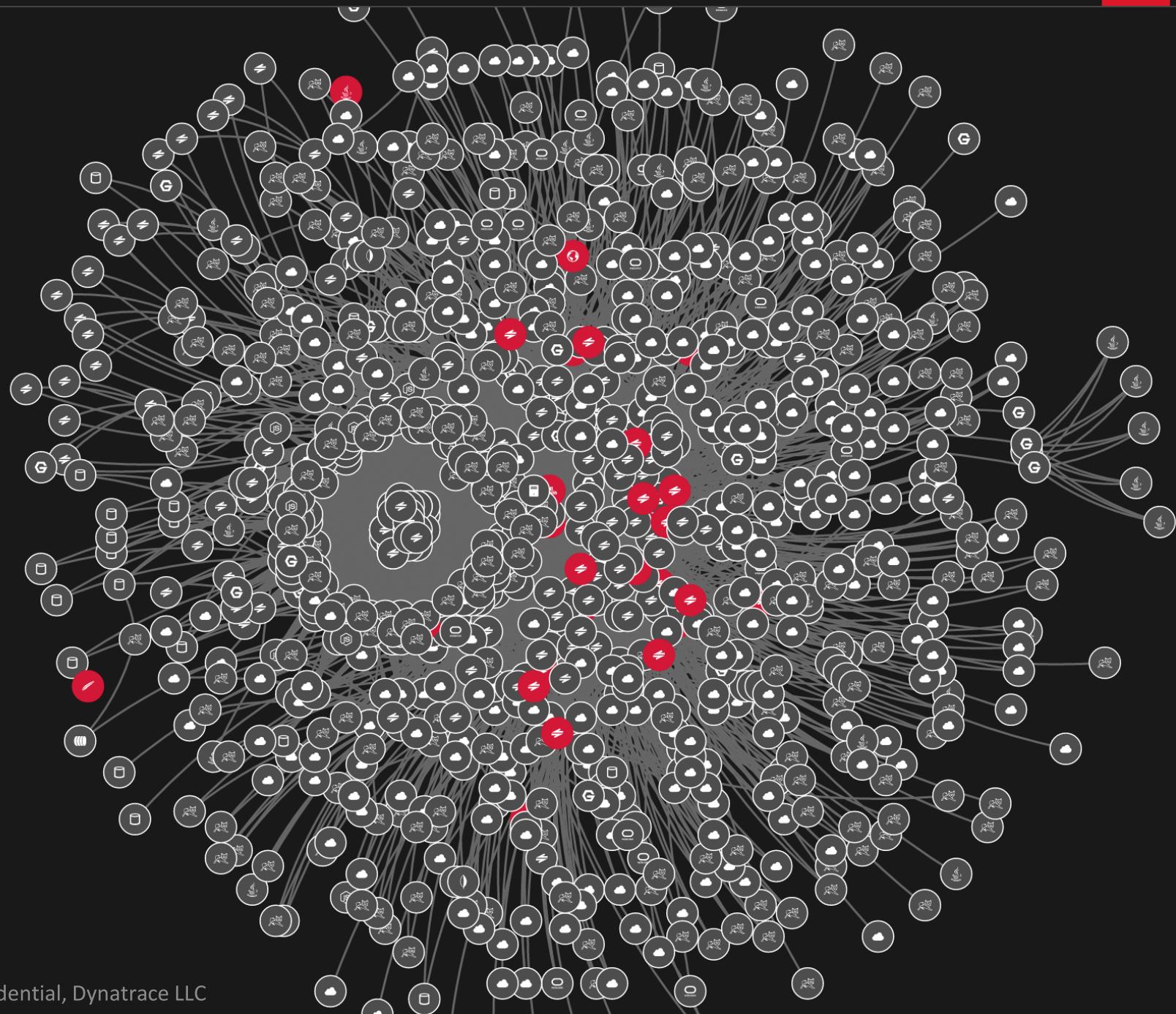
3/10424

 Hosts

142

 Datacenters

7



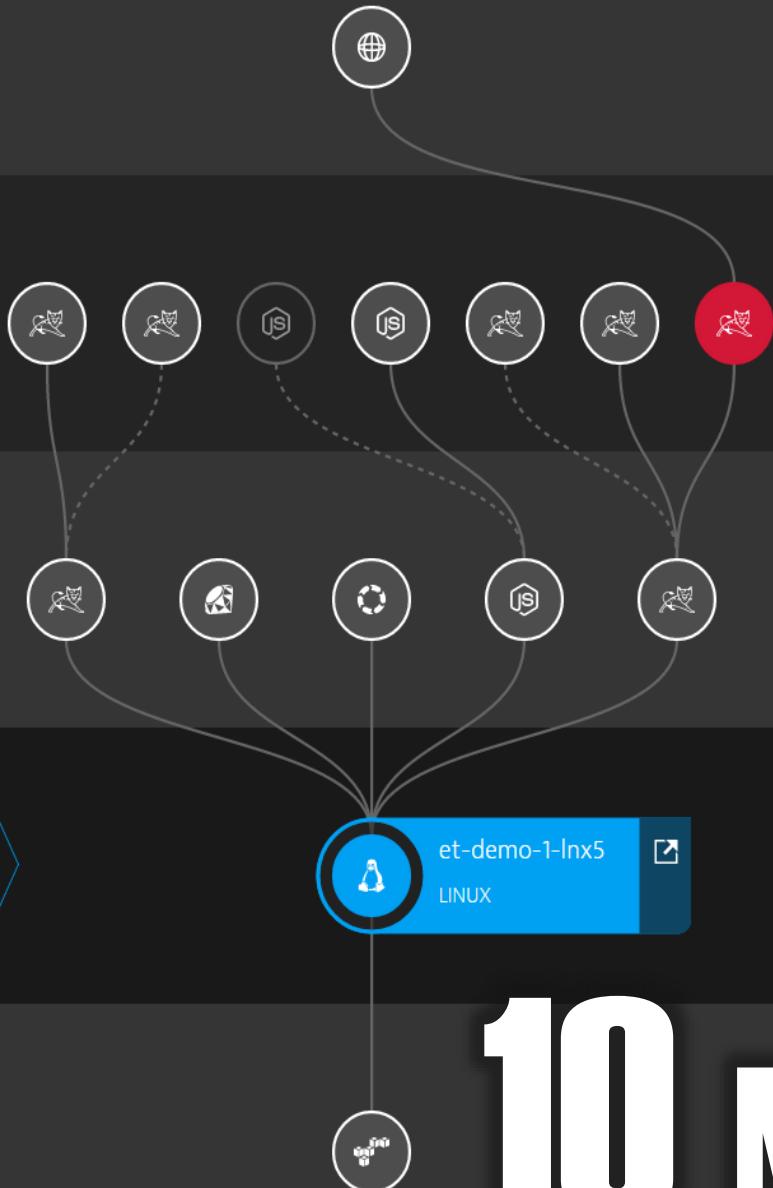
Applications

Services

Processes

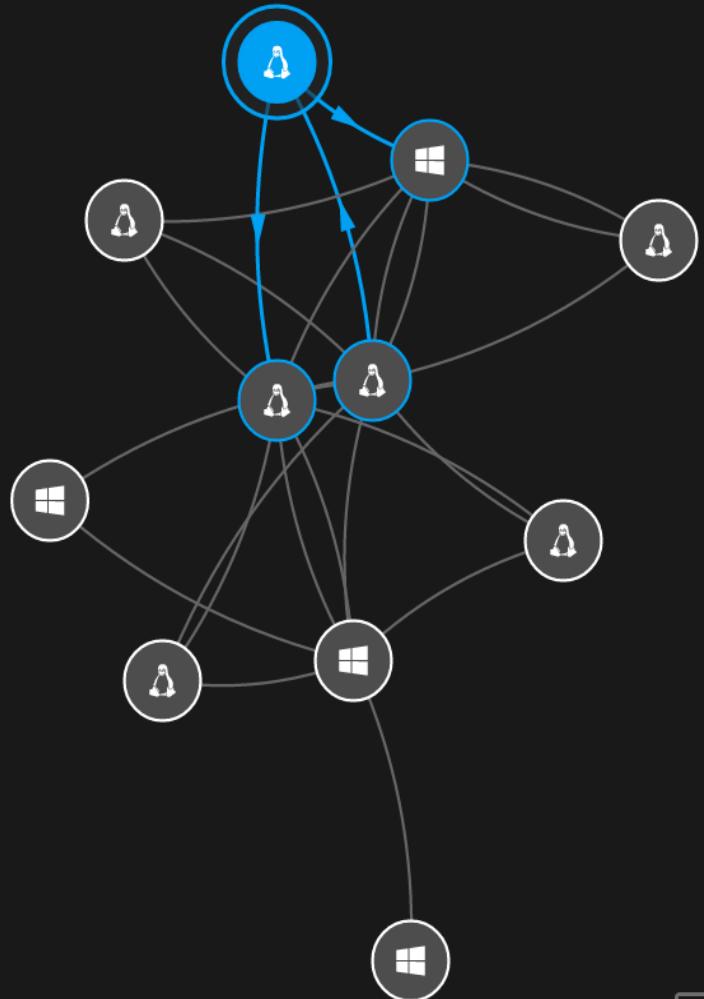
 Hosts
17

Datacenters



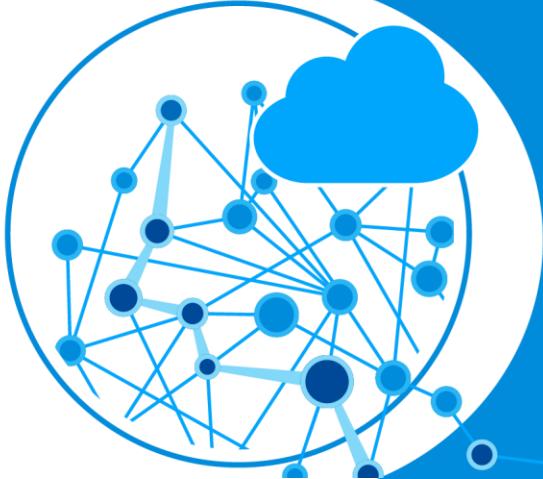
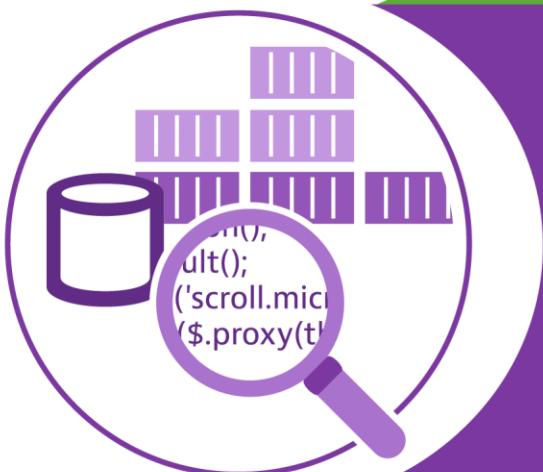
10 Million

dependencies

파
데
이
EM
O
D
E
L
I
N
G



ONE
AGENT



Browser



Mobile*



3rd parties



Application- & Webserver



Services



Containers, Processes,
Logs



OS, Disks



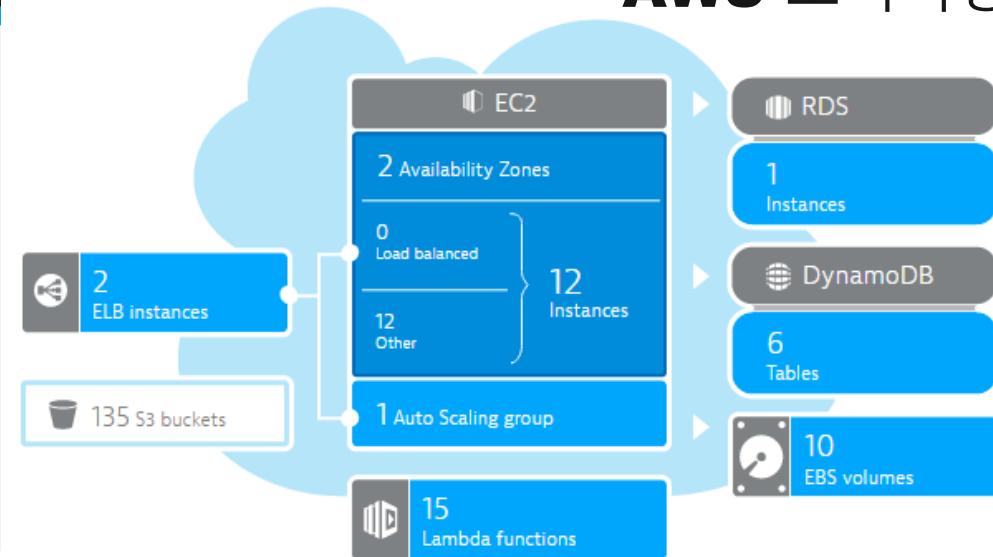
Cloud



Network



AWS 모니터링



CLOUD

기술지원

Docker 모니터링

This dashboard shows Docker usage statistics. Key metrics include 14 running containers, 11 Dockerized services, and 3.32k/min requests. It also displays resource consumption for top containers and images, and a bar chart showing the average number of running containers over the last 7 days.

OpenStack 모니터링

This dashboard provides a detailed view of OpenStack components. It shows the Controller (Keystone, Glance, Horizon, RabbitMQ, Memcached, Database) and Compute (Hypervisors, Virtual machines, Neutron subnets, Cinder volumes, Databases, Swift objects) layers. A summary indicates 15 Hypervisors and 45 Virtual machines are running. Below, a chart tracks environment dynamics daily, and a table details Hypervisor usage.

Name	No. of VMs	vCPU	Memory	Used disk space	Load	Details
Hypervisor 1	25 %	8	705 MB	10 %	54 kbit/s	Details
Hypervisor 2	20 %	2	733 MB	25 %	25 kbit/s	Details

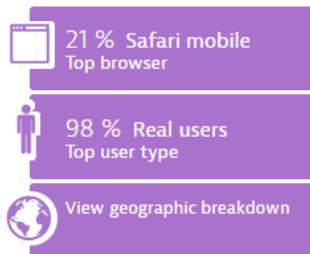
VMWare 모니터링

This dashboard focuses on vCenter monitoring. It shows environment dynamics for February 22, including clusters (1), ESXi hosts (2), and VMs (9). It also tracks VM activity: 0 started, 2 manual migrations, and 0 automatic migrations. Below, a chart shows the average number of virtual machines and total migrations over the last 7 days, with a note that no changes occurred compared to February 15.

ESXi host name	Virtual machines	Migrations today	CPU	Used memory	Disk latency	Network
192.168.10.69	5	2	10 %	91 % of 24 GB	35.9 ms	78.6 Mbit/s
192.168.10.68	4	2	5.56 %	84 % of 24 GB	21.5 ms	37.1 Mbit/s

Madison Island
Properties, tags, and JavaScript frameworks

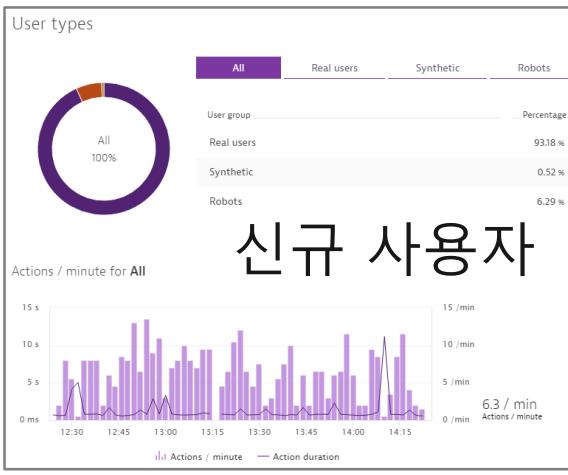
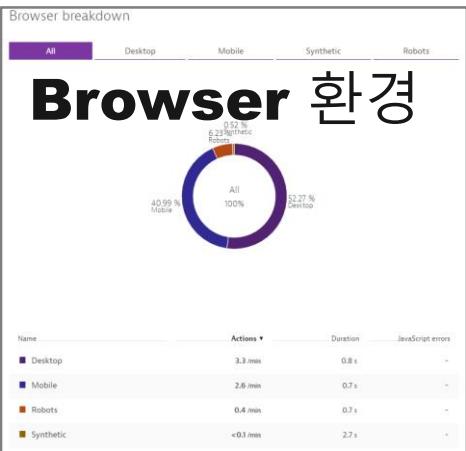
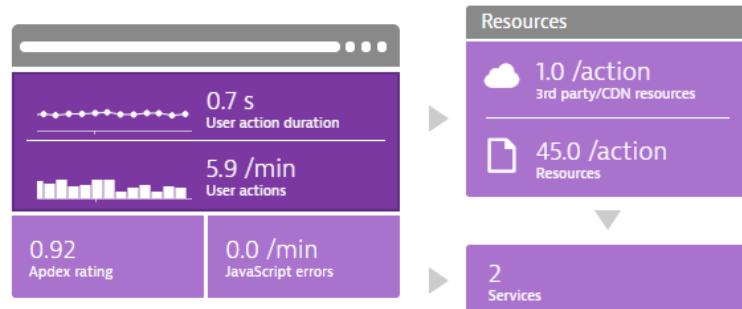
Performance analysis
Actions /min, Action duration, Apdex rating, JavaScript errors, 3rd party providers and Services.



사용자 접속 현황 및 체감 성능

Filter user types

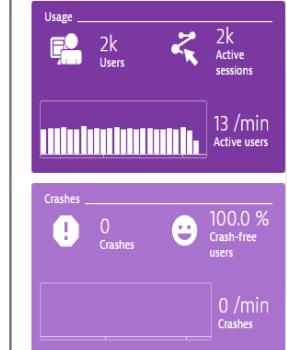
Start typing to filter...



easyTravel Demo
Mobile application (Android, iOS)

+ Add tag

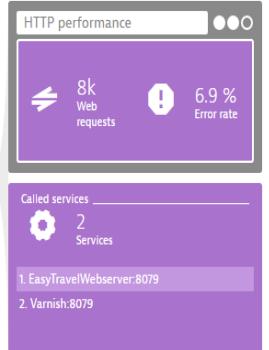
All



모바일 성능

Pin to dashboard

...



Crashes			
UImage.swift:74 NSDemoException	Today, 07:26	13	13
Total crashes	Occurrences	Impacted users	13

Occurrence statistics

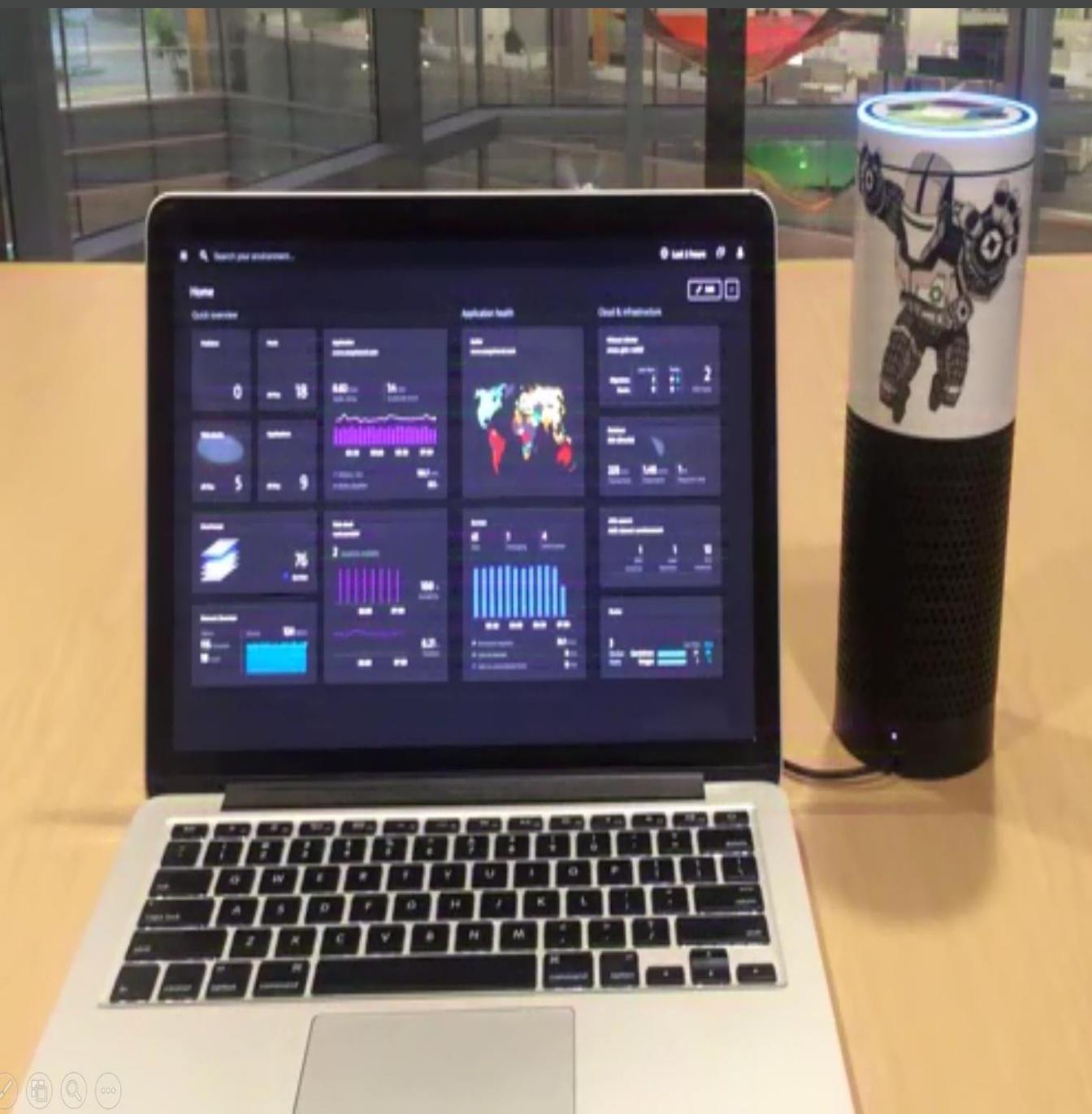
iOS 46% iOS 6.1
Operating system 46% 640x1136 Retina
Device resolution iPhone 5 (Apple)
Most used device 69% 5.7.6
App version

모바일 Crash 정보

Signal: SIGTRAP
NSDemoException: iOS Crash Reason

```
objc static ext.ruxit.e.ObjectiveC.UImage.ruxitSafariIcon.getter : ObjectiveC.UImage (UImage.swift : 74)
ruxit.e_ProblemViewController.init (ruxit.e_ProblemViewController.Type) ->
ruxit.e_ProblemViewController (ProBLEMViewController.swift : 74)
function signature specialization <Arg[0] = Dead, Arg[1] = Dead> of function signature
specialization <Arg[0] = Owned To Guaranteed, Arg[1] = Owned To Guaranteed, Arg[2] = Owned To Guaranteed> of ruxit.e_AppDelegate.application (ruxit.e_AppDelegate)
(ObjectiveC.UIAApplication, didFinishLaunchingWithOptions : ObjectiveC.NSObject : Swift.AnyObject) -> Swift.Bool (<unknown> : 57)
objc ruxit.e_AppDelegate.application (ruxit.e_AppDelegate) (ObjectiveC.UIAApplication, didFinishLaunchingWithOptions : ObjectiveC.NSObject : Swift.AnyObject?) ->
Swift.Bool (<unknown> : 0)
-UIApplication_handleDelegateCallbacksWithOptions(isSuspended:restoreState:) + 370
-UIApplication_callInitializationDelegatesForMainScene:transitionContext: + 2440
-UIApplication_runWithMainScene:transitionContext:completion: + 1408
-84-[UIApplication _handleApplicationActivationWithScene:transitionContext:completion:]_block_invoke + 32
-UIApplication_workspaceDidEndTransaction: + 128
-31-[FBSSerialQueue performAsync:block:invoke_2 + 14
_CFRUNLOOP_IS_CALLING_OUT_TO_A_BLOCK_ + 10
_CFRUNLoopDoBlocks + 212
_CFRUNLoopRun + 1710
_CFRUNLoopRunSpecific + 472
CFRunLoopRunInMode + 102
-[UIApplication _run] + 554
UIApplicationMain + 1436
```

사용자 체감 성능



음성인식
비서

Dynatrace – 업계 최초 Unrivalled Features



Artificial
Intelligent

Big Data
Fully Automated

One
Agent

UX /
IoT Ready

Virtual
Assistant

Flexible Deployment



SaaS - Cloud



Managed - On
Premise

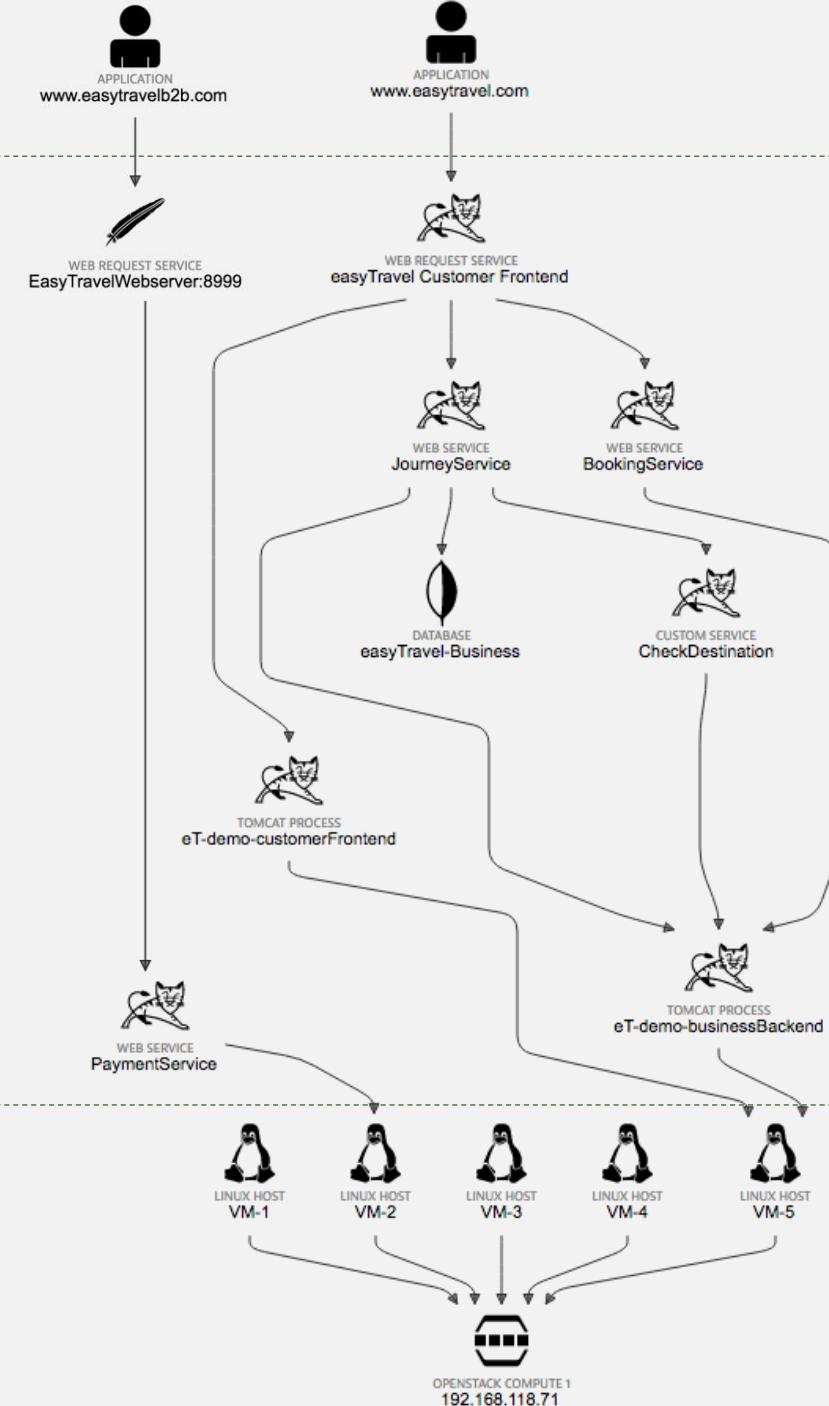
“사용자 개인 Behavior 및 성능/오류”

Microservice Architecture

“어플리케이션”



“Cloud Infra. 환경”



OpenStack Platform 모니터링

OpenStack Demo environment

OpenStack
Uptime: over 47 day

Properties ...
Ubuntu 16.04.1 LTS (Xenial)

8 Virtual Machines
3 Compute Nodes
1 Controller Node

Actively used CPU of the

100 %

17 % CPU
62 % Memory

1 NIC
2 Disks

6 log files updated in last 72 hours
This process writes to 6 log files on OpenStackControllerNode
Can't see important log entries? [Configure more log files](#)

/var/log/apache2/access.log (42.2 kB)
/var/log/apache2/keystone.log (17.7 kB)
/var/log/apache2/keystone.log.# (8.98 kB)
/var/log/apache2/keystone_access.log (15.9 MB)
/var/log/apache2/keystone_access.log.# (8.71 MB)
/var/log/keystone/keystone.log (347 kB)

View all log entries

Log files

Consuming processes

23. Jun 24. Jun 25. Jun

Steal time I/O wait Other

Processes

OpenStack

Ceilometer-polling
Cinder-API
Cinder-scheduler
Cinder-volume
Glance-API
Glance-registry
Horizon
Keystone
Neutron-dhcp-agent
Neutron-l3-agent
Neutron-lbaas-agent
Neutron-metadata-agent
Neutron-metering-agent
Neutron-ns-metadata-proxy
Neutron-openvswitch-agent
Neutron-rootwrap
Neutron-server
Nova-api-metadata
Nova-api-os-compute
Nova-cert
Nova-conductor
Nova-scheduler

MySQL

MySQL

HAProxy

haproxy

Memcached

Memcached

RabbitMQ

RabbitMQ

MongoDB

MongoDB

Erlang

Erlang Port Mapper

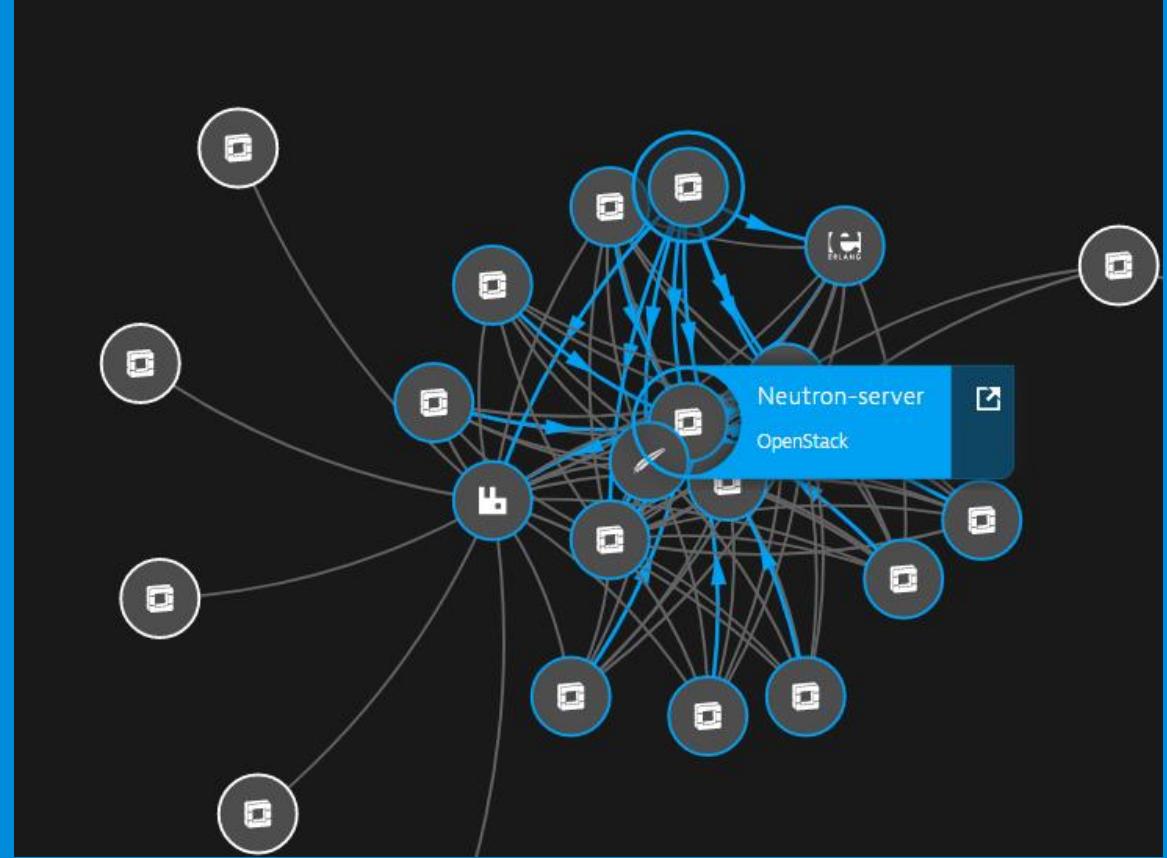
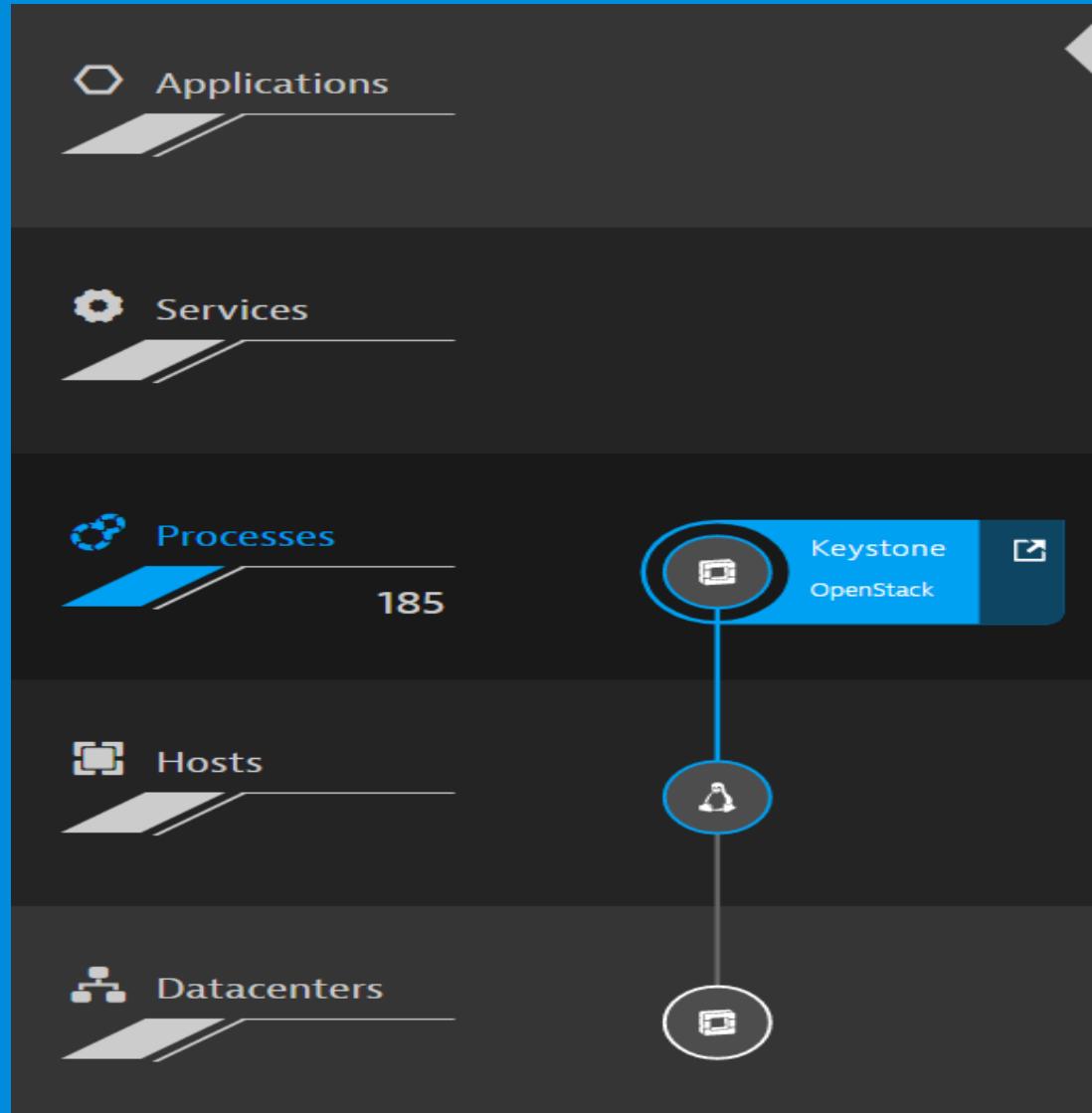
Apache HTTP Server

Apache Web Server apache2

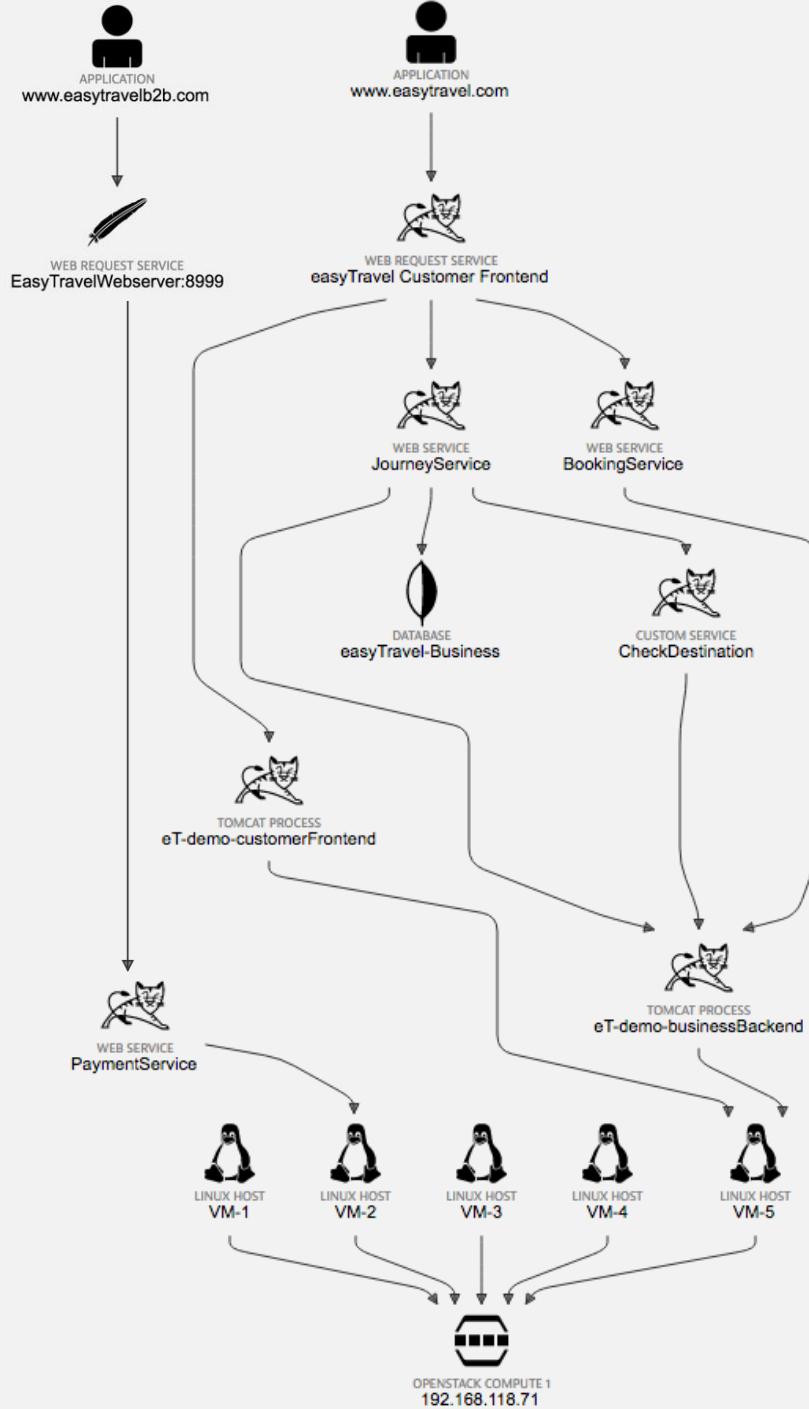
OpenStack Components

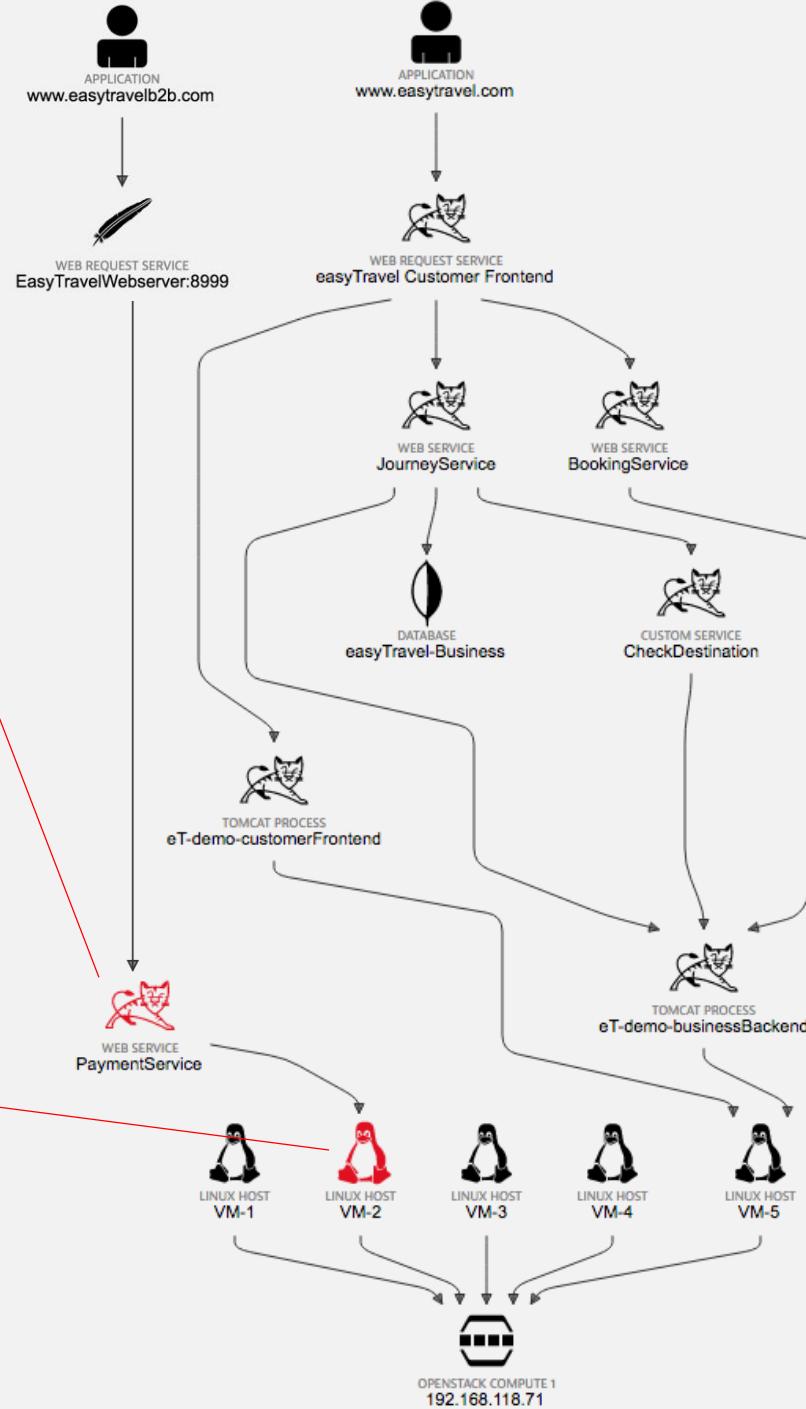
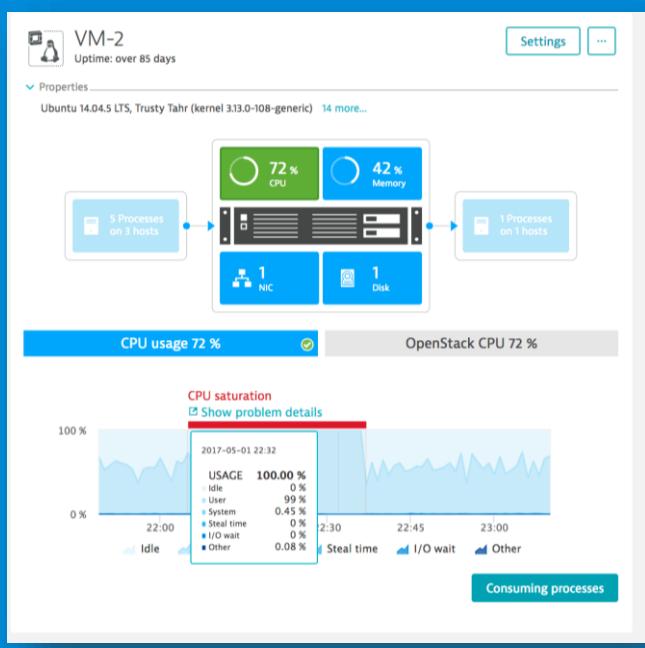
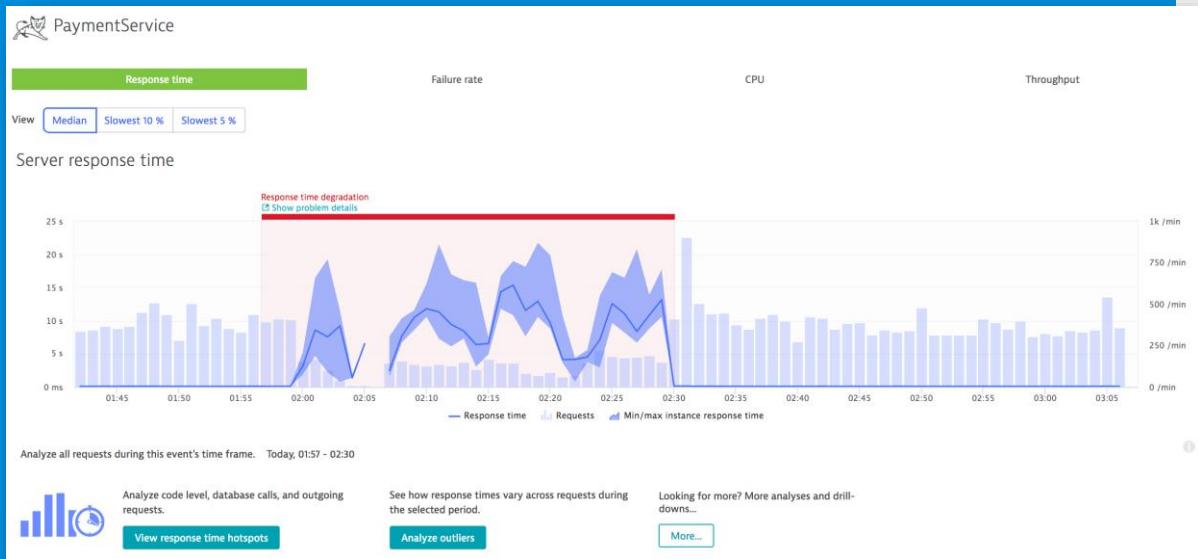
연계 Service

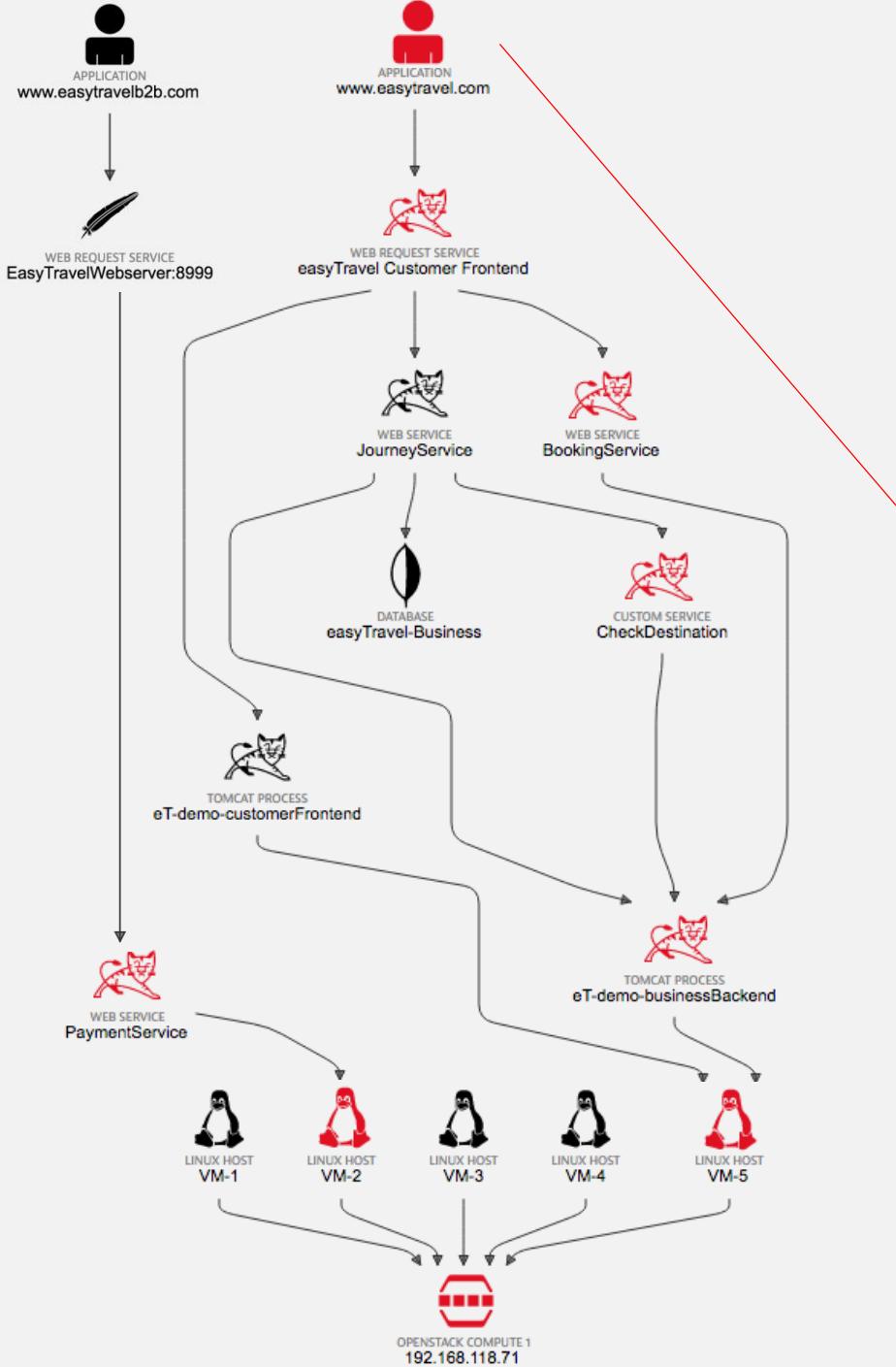
OpenStack Platform 모니터링



서비스 연결 정보







The screenshot shows the New Relic application performance monitoring dashboard for the domain www.easytravel.com:

Performance analysis

Actions /min, Action duration, Apdex rating, JavaScript errors, 3rd party providers and Services.

Filter user types: auto-filtered: Chrome 38

Resources

- 0.0 /action 3rd party/CDN resources
- 22.3 /action Resources
- 1 Services

Actions

Show the slowest 10% of actions for all actions

Impact of user activity on action duration

User action duration degradation

Time consumed Actions /min

Action	Time consumed	Actions /min
Loading of page /	Actions 0.93 /min	Actions 0.93 /min
Loading of page /Report	Actions 0.87 /min	Actions 0.87 /min
Loading of page /Booking	Actions 0.85 /min	Actions 0.85 /min

Compare to previous time frame

Top 3 user actions

These are the top user actions by looking on their consumption (action duration and frequency). Open the full details view for looking at other actions and more metrics.

Action	Time consumed	Actions /min
Loading of page /	Actions 0.93 /min	Actions 0.93 /min
Loading of page /Report	Actions 0.87 /min	Actions 0.87 /min
Loading of page /Booking	Actions 0.85 /min	Actions 0.85 /min

View full details

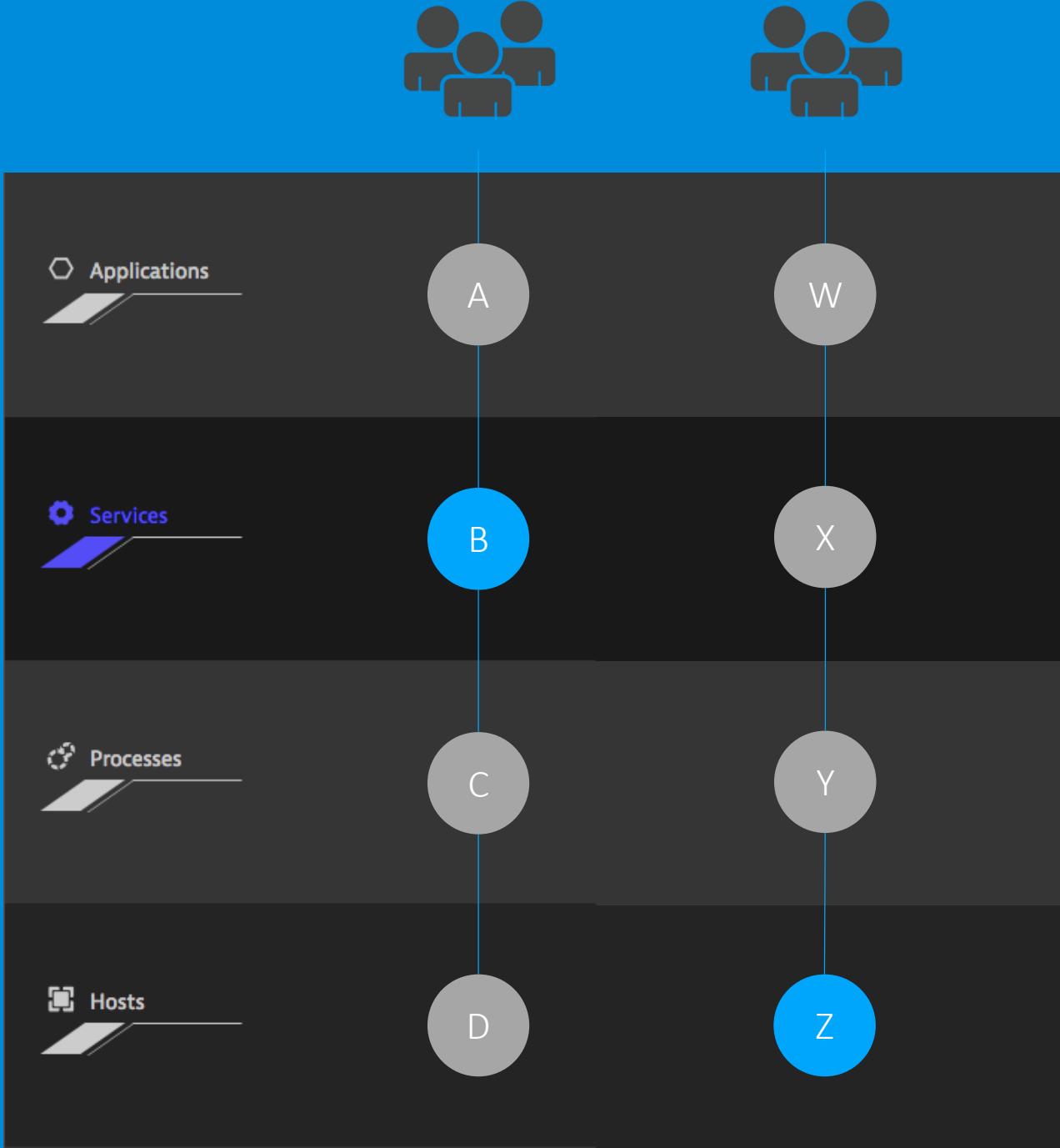
User behavior

Active sessions, Actions per session, Entry/Exit actions, Bounce rate, and Conversion goals.

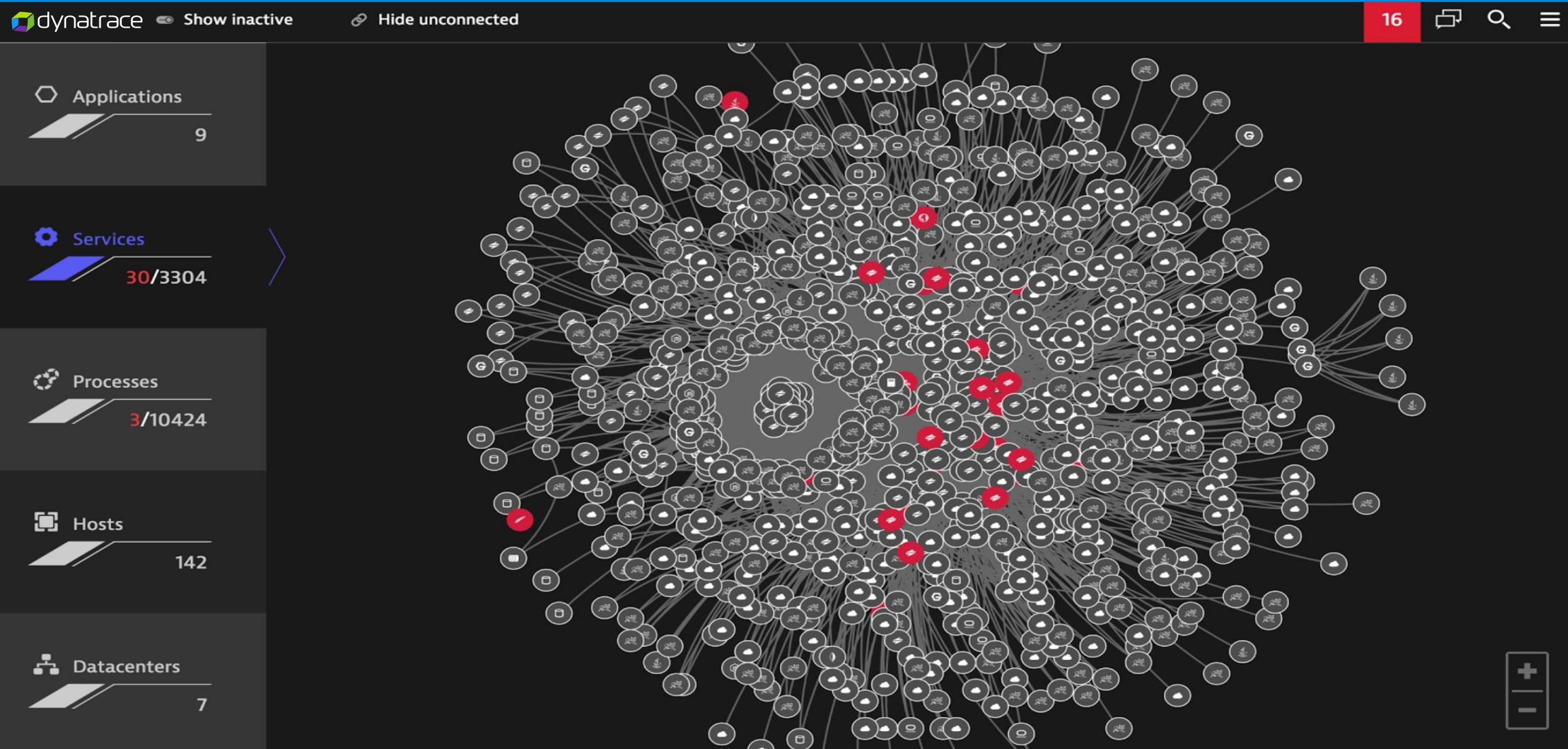
Correlation vs. Causation

- 상관관계 (Correlation) : 일정한 수치로 계산되어 두 대상이 서로 관련성이 있다고 추측되는 관계
- 인과관계(Causation) : 어떤 선행사실(원인)과 후행사실(결과)의 필연적 관계

B Z
PaymentService 응답시간 Host CPU > 90%
2초 증가



Dynamic & Large Scale 어플리케이션 - Correlation



Dynamic & Large Scale 어플리케이션 - Causation



APPLICATION
www.easytravel.com

WEB REQUEST SERVICE
Varnish:8079

WEB REQUEST SERVICE
easyTravel Customer Frontend

WEB REQUEST SERVICE
eT-demo-1-Frontend-LoadBalancer on port *

APACHE HTTP SERVER PROCESS
eT-demo-1-Fro...-LoadBalancer

APACHE TOMCAT PROCESS
eT-demo-1-CustomerFrontend

APACHE TOMCAT PROCESS
eT-demo-1-CustomerFrontend

APACHE TOMCAT PROCESS
eT-demo-1-CustomerFrontend

APACHE TOMCAT PROCESS
eT-demo-1-CustomerFrontend

정상



APPLICATION
www.easytravel.com

WEB REQUEST SERVICE
Varnish:8079

WEB REQUEST SERVICE
easyTravel Customer Frontend

WEB REQUEST SERVICE
eT-demo-1-Frontend-LoadBalancer on port *

APACHE HTTP SERVER PROCESS
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APACHE TOMCAT PROCESS
eT-demo-1-CustomerFrontend

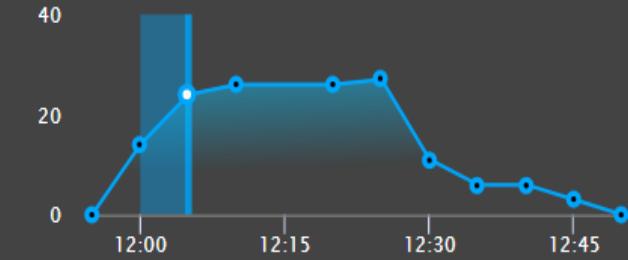
APACHE TOMCAT PROCESS
eT-demo-1-CustomerFrontend

APACHE TOMCAT PROCESS
eT-demo-1-CustomerFrontend

APACHE TOMCAT PROCESS
eT-demo-1-CustomerFrontend

장애

Problem evolution



Apache HTTP Server process

eT-demo-1-Frontend-LoadBalancer

► Packet retransmission rate for process eT-demo-1 ...

Apache Tomcat process

eT-demo-1-CustomerFrontend

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eT-demo-1-CustomerFrontend

► Packet retransmission rate for process eT-demo-1 ...

Dynamic & Large Scale 어플리케이션 - Causation



www.easytravel.com: User action duration degradation

Problem 749 detected at Jul 4 11:58 - Jul 4 12:47 (was open for 49 minutes). This problem affects real users.

	Affected	Recovered	Monitored	
Applications	-	1	26	
Services	-	1	101	
Infrastructure components	-	5	688	

Dependency 수



48,780,576

Dependencies analyzed



www.easytravel.com
Application

User action duration degradation

The current response time (16.8 s) exceeds the auto-detected baseline (2.28 s) by 639 %

Affected user actions

719/min

User action

All

Browser

All

Geolocation

All

OS

All

영향 / 중요도

문제 원인

Root cause

Based on our dependency analysis all incidents have the same root cause:



eT-demo-1-CustomerFrontend
Process

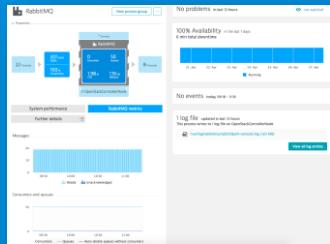


Network problem

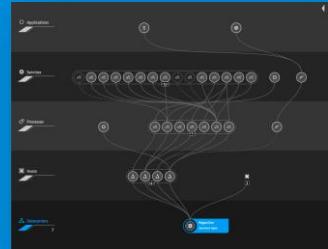
Packet retransmission rate for process eT-demo-1-CustomerFrontend on host CF4-tomcatjms has increased to 17 %



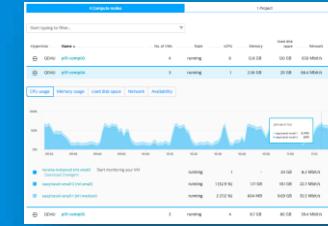
Analyze logs



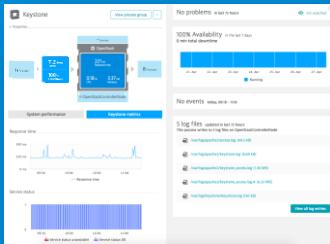
Supporting services



Dependencies



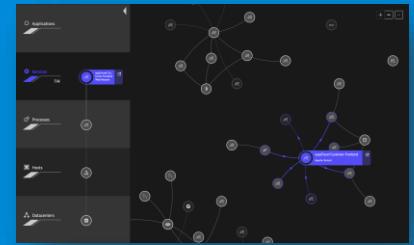
Resource capacity & utilization



OpenStack service availability /performance



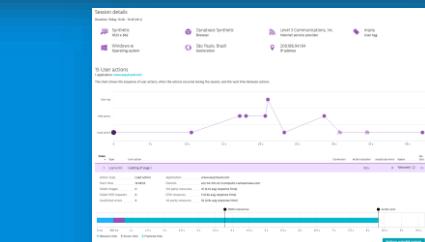
Log files



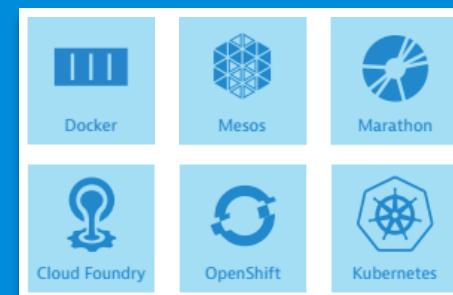
Applications running on top



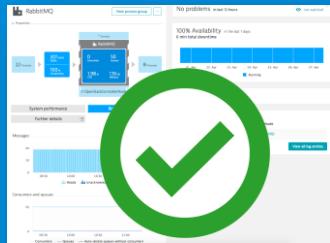
Correlation of metrics/events/data & Causation



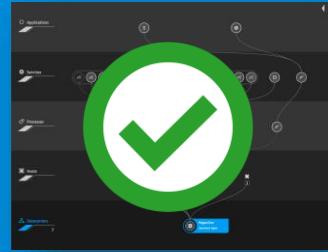
Real user monitoring,
UX affects \$



PaaS



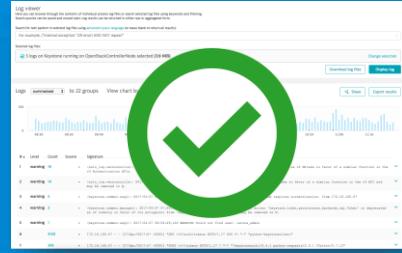
Supporting services



Dependencies



Resource capacity &
utilization



Log files



OpenStack service availability
/performance

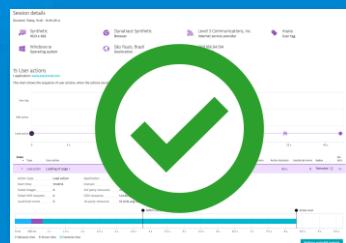
dynatrace



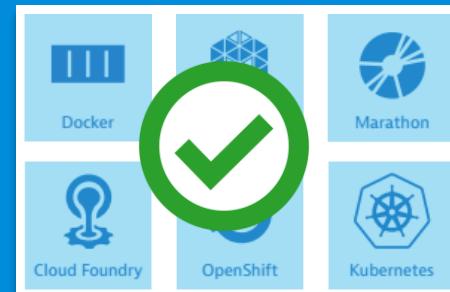
Applications running
on top



Correlation of metrics/events/data
& Causation

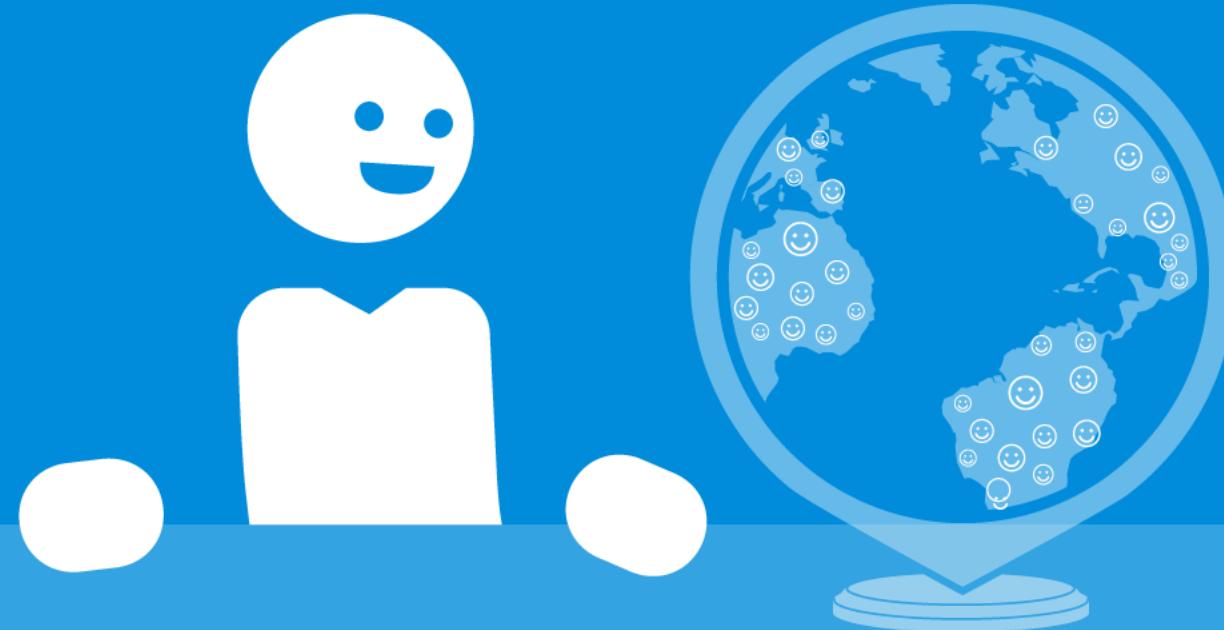


Real user monitoring,
UX affects \$



PaaS

우리의 Vision은 Digital Virtual Assistant



환경과 데이터의 복잡도 증가로 인하여 더 이상
사람이 효과적으로 관리할 수 없는 시점에 도달



www.dynatrace.com