

멀티 플레이어 게임 레퍼런스 아키텍처로 살펴보는 클라우드 네이티브

최영락

December 2021

목차

1. 게임 백엔드 기술과 멀티 플레이어 게임
2. 게임 개발과 클라우드 네이티브 기술
3. 데모: RPSLS – 마이크로서비스 아키텍처 게임과 쿠버네티스

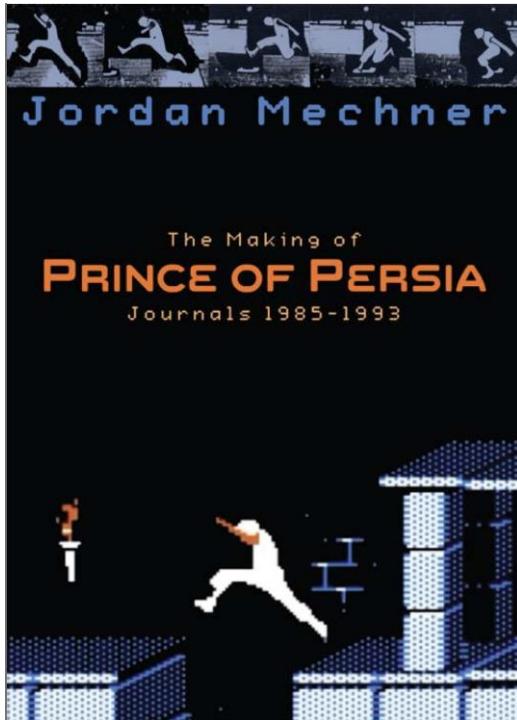
1. 게임 백엔드 기술과 멀티 플레이어 게임

(부제: 클라우드가 없던
시절부터...)



오프라인 게임





JANUARY 23, 1987

Progress on *Prince of Persia* has slowed to a snail's crawl. I've been drifting in to work around eleven or twelve, and between that, the Butchery and the Sport Court, my workday is about forty-five minutes long. Ed and Gene and Lauren keep checking in to see what new and exciting stuff I've got up on the screen, and they go away disappointed.

Instead, I've been spending my time playing with my new Mac, Radius screen, and Scriptor screenplay formatting software. Shiny new toys.

41

JANUARY 26, 1987

Got up early for a change and put in a full day's work on the game. Corey talked me into switching assemblers, operating systems, and disk media (from DOS 3.3, S-C Assembler, and 5 1/4" floppies to ProDOS, Merlin, and SCSI hard drive). The change should take about a week, but I think it'll pay for itself in the end.

[jmechner / Prince-of-Persia-Apple-II](#) (Public)

[Code](#) [Issues](#) [Pull requests](#) [Actions](#) [Projects](#) [Wiki](#) [Security](#) [Insights](#)

[Notifications](#) [Star](#) 5.6k [Fork](#) 623

[master](#) [1 branch](#) [0 tags](#)

[Go to file](#) [Code](#)

sethwoodworth Merge pull request #17 from OdineiRibeiro/master ... a9e276c on Apr 13, 2017 [21 commits](#)

| | | |
|--------------------------------------|--|--------------|
| 01 POP Source | Added more files | 10 years ago |
| 02 POP Disk Routines | Attempted line ending fix | 10 years ago |
| 03 Disk Protection | Attempted line ending fix | 10 years ago |
| 04 Support | Added more files | 10 years ago |
| .gitattributes | Some tweaks | 10 years ago |
| LICENSE | Making things easier, linking license to README. | 10 years ago |
| README.md | refactored readme links | 5 years ago |

About
A running-jumping-swordfighting game I made on the Apple II from 1985-89

[jordanmechner.com/ebook](#)

[Readme](#) [View license](#)

Releases
No releases published

MEMORY USE

The Apple version uses memory, roughly, as follows:

| | RAM (during game play) | DISK |
|--------------------------------|---------------------------|------------------|
| Image tables | | |
| Player | 30K | 30K |
| Enemy | 6K | x5 = 30K |
| Princess & Vizier | | 9K |
| Background | 13.5K | x2 = 27K |
| TOTAL IMAGE TABLES | 49.5K | 96K |
| Code | 48K | 48K |
| Buffer space | 8K | |
| Music | 4K | 6K |
| Level blueprint | 2.25K | x16 = 54K |
| Screen memory | 16K | |
| TOTAL RAM | 127.75K | |
| Packed dblhires screens | | 42K |
| Packed princess's room | | 6.5K |
| TOTAL DISK SPACE | | 252.5K |

머드 (Multi User Dungeon) 게임

당신의 장비:

| | |
|-------|-----------------------|
| <조명> | 검은 수정 |
| <머리> | 붉은 머리띠 |
| <목> | 핸슨의 머플러(숨겨진 장비) |
| <어깨> | 아리만의 어깨 보호대 |
| <몸둘레> | 암흑천사의 날개(숨겨진 장비) |
| <몸통> | 은회색 로브(숨겨진 장비) |
| <팔> | 건더슨의 팔 보호대(숨겨진 장비) |
| <방패> | 해골 방패(+) |
| <손목> | 암흑천사의 팔찌(숨겨진 장비) |
| <장갑> | 검은 장갑 |
| <반지> | 오페 반지(마법반지) |
| <오른손> | (마법무기) 사파이어 흰표범발톱(물+) |
| <왼손> | 오크의 석궁(숨겨진 장비) |
| <허리> | 보석 벨트 |
| <다리> | 트롤 다리 보호대 |
| <무릎> | 검은 무릎 보호대 |
| <발> | 아네스의 부츠 |

<8398체력 7000마법력 8264이동력>

>>*<< 202호(비스크)>>*<<

방이 깔끔히 정돈되어 있습니다.

[출구: 동(닫힌문)]

<물건> 커다란 침대가 놓여 있습니다.

시민이 생업에 종사하고 있습니다.

(절망) 마녀 비비안이 요염한 포즈로 침대에 앉아 있습니다.

〈 머드 제작 관련 자료실

* Linux 환경에서 자동실행 :

만약 게임이 종료하여도 게임이 계속 실행되게 하려면 bin 디렉토리에서 startmud 파일과 HanLP.info 파일을 열고 게임이 설치된 디렉토리의 경로를 정확하게 입력한 후 startmud를 실행하면 됩니다.

(예: ./startmud ./HanLP &)

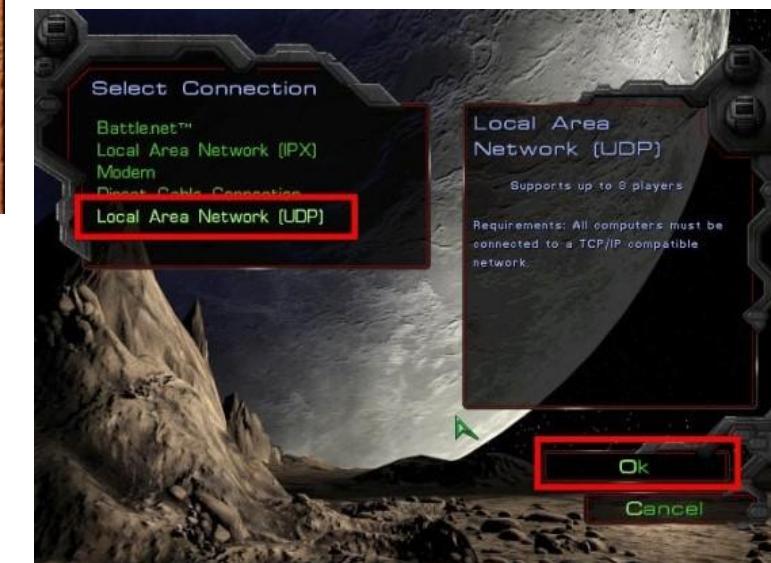
* Windows 환경에서의 자동실행 :

늘 리눅스와 쓸라리스만 사용하다 보니 제가 윈도우 환경에 익숙하지가 않아 방법을 알지 못하고 있습니다만, 적당한 배치화일을 만들어 주면 가능하다고 들었습니다. ^^;;;

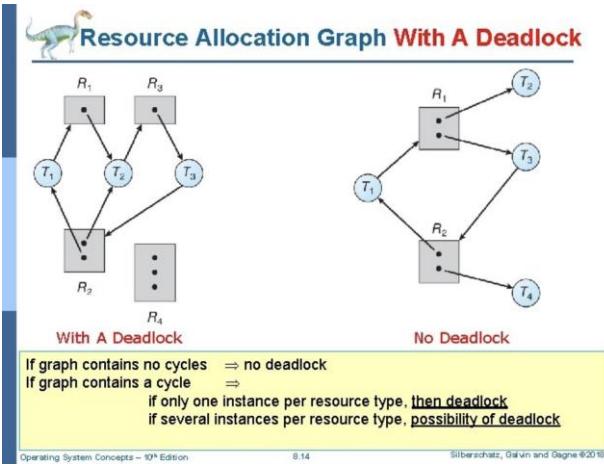
* Windows 환경에서의 실행시 주의할 점 :

Windows98에서는 실행과 게임이 되지만 플레이어가 게임을 종료할 때 소켓이 닫히지 않는 버그가 있습니다. 이것은 Windows98의 Windock 자체의 버그때문인것으로 보입니다. 혼자서 게임을 즐기실때는 아무런 문제가 없습니다만 공개적으로 게임을 운영하려고 한다면 Window2000이나 WindowsXP 등을 이용하시기 바랍니다.

네트워크 & 서버 기술과 함께 다양한 멀티 플레이어 게임 등장



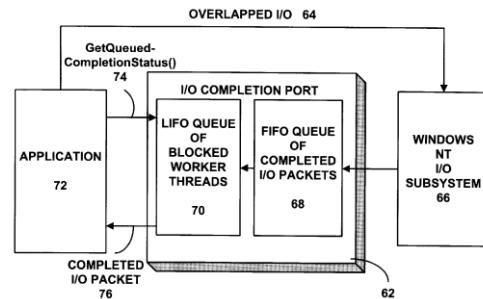
게임 백엔드 주요 기술



멀티 유저를 고려한 자원 관리 (No deadlock!)

» Epoll, Kqueue and IOCP

There are some well-known libraries which implement a cross platform event queue using Epoll, Kqueue and IOCP for Linux, Mac, and Windows, respectively.



멀티 큐 등을 활용한 효율적인 I/O 처리

Battle.net Chat Server Protocol Overview

The Battle.Net Chat Server ("BNCS") is the unofficial name of the protocol that Blizzard's Battle.net-enabled games used to communicate. The games that historically used this protocol are *Diablo*, *StarCraft*, *WarCraft II*, *Diablo II*, *WarCraft III*, and their expansions. This is now referred to as "Classic" or "Classic Battle.net" these days. The protocol operates on TCP port 6112 (and UDP port 6112 for pre-Diablo II player-to-player communication).

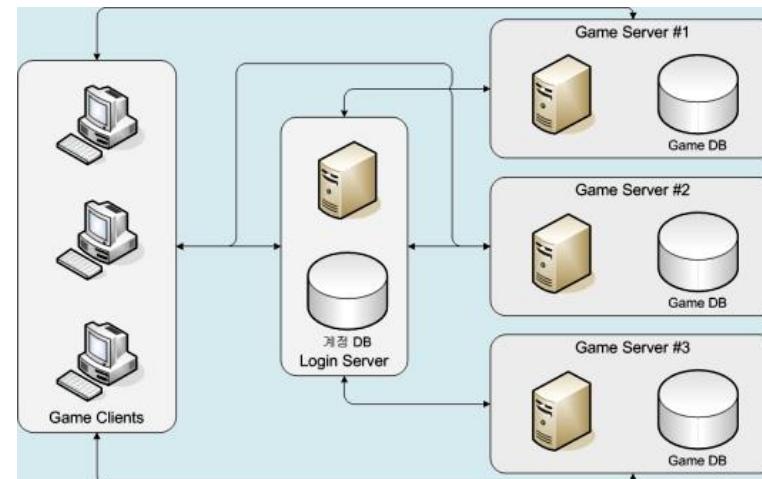
It is a binary protocol with very little encryption (it's there for password and product key exchanges, but otherwise absent), stemming from the age where every byte mattered back in 1996.

BNCS Headers

Every BNCS message has the same header:

```
(UINT8) Always 0xFF  
(UINT8) Message ID  
(UINT16) Message length, including this header  
(VOID) Message data
```

네트워크 프로토콜에 따른 패킷 정의



데이터 관리

백엔드에서
는 사용자
경험을 서버
안정성 및
"동시
접속자 수
(동접)"로
판단

+ 명확한
기획 의도
이해를
바탕으로
재미있는
게임이
만들어져야
겠죠? 😊

2. 게임 개발과 클라우드 네이티브 기술



기술 발전과 함께 보다 현실감있는 게임

예시: Flight Simulator

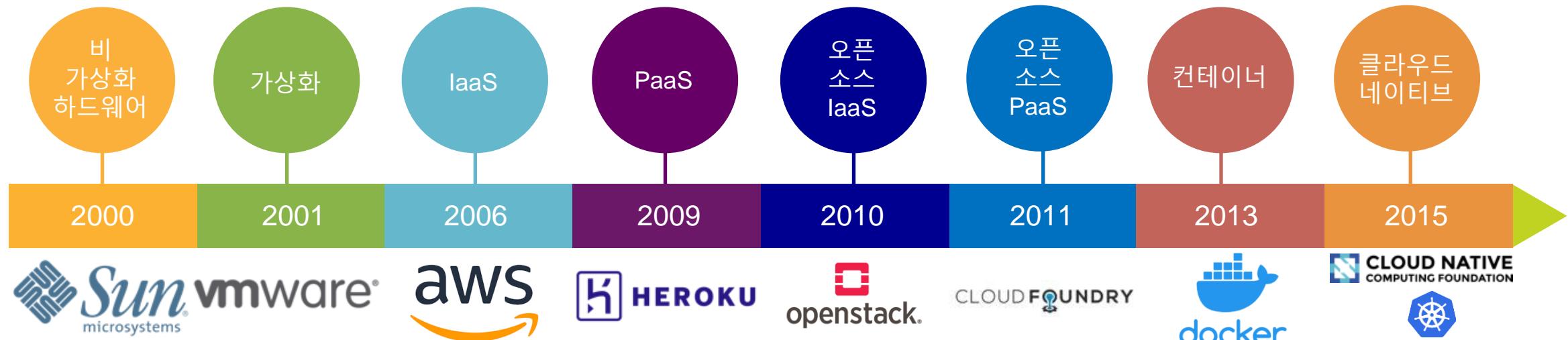
- 현실감있는 시뮬레이션
- 영상: 실시간 클라우드 Text to Speech 서비스를 활용한 이착륙 커뮤니케이션



[참고] 가상화부터 “클라우드 네이티브”까지



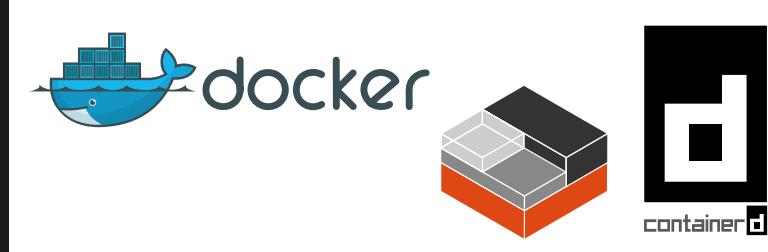
- 클라우드 네이티브 컴퓨팅에서 사용하는 오픈 소스
소프트웨어 스택:
 - 애플리케이션을 마이크로서비스로 분할,
 - 각 파트를 자체 컨테이너에 패키징 및 해당 컨테이너를 동적으로 오케스트레이션하여 리소스 사용을 최적화



(출처: Cloud Native Computing Foundation)



컨테이너 발전과 클라우드 컴퓨팅 네이티브 재단 (CNCF) 등장



ANNOUNCEMENTS

New Cloud Native Computing Foundation to drive alignment among container technologies

Posted on June 21, 2015

AT&T, Box, Cisco, Cloud Foundry Foundation, CoreOS, Cycle Computing, Docker, eBay, Goldman Sachs, Google, Huawei, IBM, Intel, Joyent, Kismatic, Mesosphere, Red Hat, Switch SUPERNAP, Twitter, Univa, VMware and Weaveworks join new effort to build and maintain cloud native distributed systems

SAN FRANCISCO, Calif., July 21, 2015 – The Linux Foundation, the nonprofit organization dedicated to accelerating the growth of Linux and collaborative development, today announced the Cloud Native Computing Foundation.



CNCF에서 정의하는 “클라우드 네이티브”

<https://github.com/cncf/toc/blob/main/DEFINITION.md#한국어>

클라우드 네이티브 기술은 조직이 퍼블릭, 프라이빗, 그리고 하이브리드 클라우드와 같은 현대적이고 동적인 환경에서 확장 가능한 애플리케이션을 개발하고 실행할 수 있게 해준다. 컨테이너, 서비스 메쉬, 마이크로서비스, 불변(Immutable) 인프라, 그리고 선언형(Declarative) API가 이러한 접근 방식의 예시들이다.

이 기술은 회복성, 관리 편의성, 가시성을 갖춘 느슨하게 결합된 시스템을 가능하게 한다. 견고한 자동화 기능을 함께 사용하면, 엔지니어는 영향이 큰 변경을 최소한의 노력으로 자주, 예측 가능하게 수행할 수 있다.

Cloud Native Computing Foundation은 벤더 중립적인 오픈 소스 프로젝트 생태계를 육성하고 유지함으로써 해당 패러다임 채택을 촉진한다. 우리 재단은 최신 기술 수준의 패턴을 대중화하여 이런 혁신을 누구나 접근 가능하도록 한다.

“클라우드 네이티브”를 위한 여정 (Trail Map)

1. CONTAINERIZATION

- Commonly done with Docker containers
- Any size application and dependencies (even PDP-11 code running on an emulator) can be containerized
- Over time, you should aspire towards splitting suitable applications and writing future functionality as microservices



3. ORCHESTRATION & APPLICATION DEFINITION

- Kubernetes is the market-leading orchestration solution
- You should select a Certified Kubernetes Distribution, Hosted Platform, or Installer: cncf.io/ck
- Helm Charts help you define, install, and upgrade even the most complex Kubernetes application



CNCF Graduated

CNCF Graduated

2. CI/CD

- Setup Continuous Integration/Continuous Delivery (CI/CD) so that changes to your source code automatically result in a new container being built, tested, and deployed to staging and eventually, perhaps, to production
- Setup automated rollouts, roll backs and testing
- Argo is a set of Kubernetes-native tools for deploying and running jobs, applications, workflows, and events using GitOps paradigms such as continuous and progressive delivery and MLOps



4. OBSERVABILITY & ANALYSIS

- Pick solutions for monitoring, logging and tracing
- Consider CNCF projects Prometheus for monitoring, Fluentd for logging and Jaeger for Tracing
- For tracing, look for an OpenTracing-compatible implementation like Jaeger



CNCF Graduated



CNCF Graduated



CLOUD NATIVE TRAIL MAP

The Cloud Native Trail Map has a larger number of options. The Cloud Native Trail Map is a recommended step for learning about services, cloud native technologies. At each step, you can choose a vendor-supported offering or do it yourself, and every step of the way is optional based on your circumstances.

HELP ALONG THE WAY

A. Training and Certification

- Consider training offerings from CNCF and then take the exam to become a Certified Kubernetes Administrator or a Certified Kubernetes Application Developer.

B. Consulting Help

- If you're getting started with Kubernetes and the surrounding ecosystem, consider leveraging a Kubernetes Certified Service Provider.

C. Join CNCF's End User Community

- For companies that don't offer cloud native services externally:

WHAT IS CLOUD NATIVE?

Cloud native technologies empower organizations to build and run scalable applications in modern, dynamic environments such as public, private, and hybrid clouds. Containers, service meshes, microservices, immutable infrastructure, and declarative APIs exemplify this approach.

These techniques enable loosely coupled systems that are resilient, manageable, and observable. Combined with robust automation, they allow engineers to make high-impact changes frequently and predictably with minimal toil.

The Cloud Native Computing Foundation seeks to drive adoption of this paradigm by fostering and sustaining an ecosystem of open source, vendor-neutral projects. We democratize state-of-the-art patterns to make these innovations accessible for everyone.

I.cncf.io
v20200501

QR code

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6. NETWORKING, POLICY, & SECURITY

- To enable inter-service networking, use a CNCF compliant network project like Calico, Flannel, or Weave Net. Open Policy Agent (OPA) is a general purpose language which uses policy authorisation and admission control to enable fine-grained security in Kubernetes.

7. DISTRIBUTED DATABASE & STORAGE

When you need more resilience than what is in a good option for running MySQL in-state, try using sharding.

Rook is a storage orchestrator that integrates a diverse set of storage solutions into Kubernetes. Serving as the 'brain' of Kubernetes, Rook provides a reliable way to store data across a cluster of machines.

It's a high-performance distributed transactional key-value store written in Rust.

Vitess is a distributed database system designed to handle large-scale, high-traffic web applications.

etcd is a distributed key-value store used for configuration management and distributed consensus.

ROOK is a distributed storage system for Kubernetes.

LINKERD is a service mesh for Kubernetes.

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Rook is a distributed storage system for Kubernetes.

Vitess is a distributed database system designed to handle large-scale, high-traffic web applications.

etcd is a distributed key-value store used for configuration management and distributed consensus.

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Landscape Guide

Reset Filters

Grouping
CNCF Relation

Sort By
Alphabetical (a to z)

Category
Any

CNCF Relation
Any

License
Any

Organization
Any

Headquarters Location
Any

Company Type
Any

Industries
Gaming, MMO Games, Onlin...

Example filters:

[Cards by age](#)

[Open source landscape](#)

[Member cards](#)

[Cards by stars](#)

[Cards from China](#)

[Certified K8s/KCSP/KTP](#)

[Cards by MCap/Funding](#)

[Download as CSV](#)



CNCF Cloud Native Interactive Landscape (2021년 하반기 기준)

The Cloud Native Trail Map ([png](#), [pdf](#)) is CNCF's recommended path through the cloud native landscape. The cloud native landscape ([png](#), [pdf](#)), serverless landscape ([png](#), [pdf](#)), and member landscape ([png](#), [pdf](#)) are dynamically generated below. Please [open](#) a pull request to correct any issues. Greyed logos are not open source. Last Updated: 2021-10-14 19:54:19Z

You are viewing 18 cards with a total of 15,949 stars, market cap of \$693.9B and funding of \$470M.



Landscape

Card Mode

Serverless

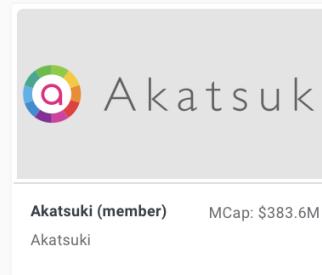
Members



Tweet

1630

CNCF Member Products/Projects (17)



Akatsuki (member) MCap: \$383.6M

Akatsuki



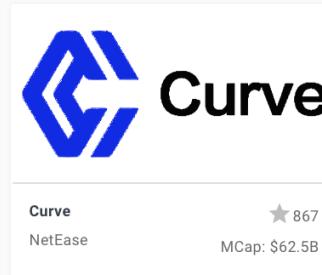
Blizzard (member) MCap: \$383.6M

Blizzard Entertainment



Blizzard (supporter) MCap: \$383.6M

Blizzard Entertainment



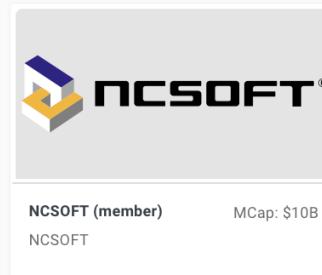
Curve NetEase ★ 867

MCap: \$62.5B



KubeCube NetEase ★ 134

MCap: \$62.5B



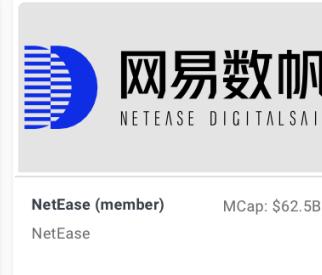
NCSoft (member) MCap: \$10B

NCSoft



Netease (KCSP) MCap: \$62.5B

NetEase



NetEase (member) MCap: \$62.5B

NetEase



Netease Qingzhou Microservice MCap: \$62.5B

NetEase



Niantic (supporter) Funding: \$470M

Niantic



Sony Interactive Entertainment (supporter) Funding: \$470M

Sony Interactive Entertainment



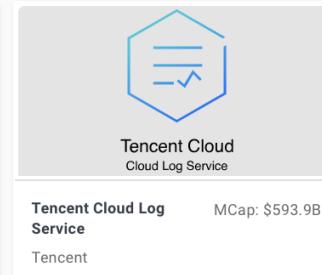
Tencent Cloud (KCSP) MCap: \$593.9B

Tencent



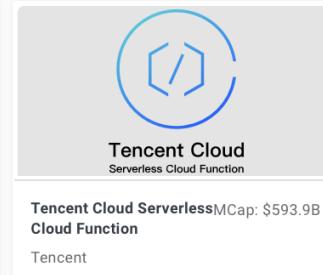
Tencent Cloud (member) MCap: \$593.9B

Tencent



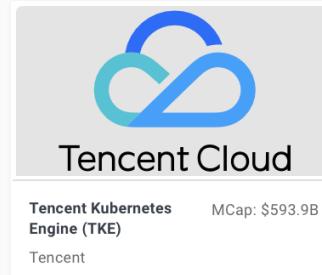
Tencent Cloud Log Service MCap: \$593.9B

Tencent



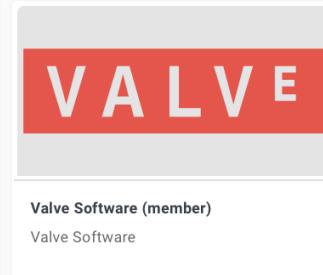
Tencent Cloud Serverless Cloud Function MCap: \$593.9B

Tencent



Tencent Kubernetes Engine (TKE) MCap: \$593.9B

Tencent



Valve Software (member) MCap: \$593.9B

Valve Software

Kubernetes(k8s)란?

Kubernetes: “컨테이너화된 응용 프로그램에 대한 자동화된 배포, 확장, 그리고 관리를 위한 오픈 소스 소프트웨어”

그리스어로 κυβερνήτης 입니다 – 배에 있는 키잡이 (Helmsman)를 의미합니다.

Docker 컨테이너가 항구/해안을 테마로 했던 것과 비슷하게, **Kubernetes**는 컨테이너가 실어지는 배 운항을 담당하는 항해사를 테마로 합니다..

CNCF (클라우드 네이티브 컴퓨팅 재단)에서 첫 번째 Graduated Project 오픈 소스

History (짧은 역사)

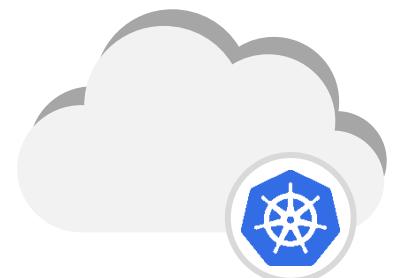
Google에서 Borg를 오픈 소스화 + 지속적인 기여 중

Kubernetes v1.0: 2015년 7월 21일 릴리즈 (Founder: Joe Beda, Brendan Burns, Craig McLuckie)

GitHub를 메인 저장 공간으로 사용 중. 기여자: >1,700;
매 3-6개월마다 릴리즈 중

Kubernetes 관련 자세한 배경 & 아이디어:

[Large-scale cluster management at Google with Borg](#) 논문 참고





Pets

Legacy Infrastructure

Pets are given names like grumpycat.petstore.com

They are unique, lovingly hand raised and cared for
When they get ill, you nurse them back to health

Infrastructure is a permanent fixture in the data center

Infrastructure takes days to create, are serviced weekly,
maintained for years, and requires migration projects to move

Infrastructure is modified during maintenance hours and
generally requires special privileges such as root access

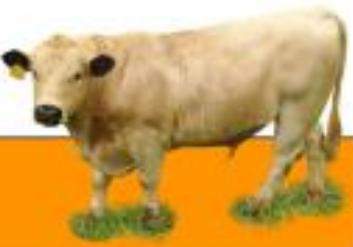
Infrastructure requires several different teams to coordinate and
provision the full environment

Infrastructure is static, requiring excess capacity to be dormant
for use during peak periods of demands

Infrastructure is an capital expenditure that charges a fix amount
regardless of usage patterns



Cattle



Cloud-Friendly Infrastructure

Cattle are given numbers like 10200713.cattlerancher.com

They are almost identical to other cattle
When they get ill, you replace them and get another

Infrastructure is stateless, ephemeral, and transient

Infrastructure is instantiated, modified, destroyed and recreated
in minutes from scratch using automated scripts

Infrastructure uses version-controlled scripts to modify any
service without requiring root access or privileged logins

Infrastructure is self-service with the ability to provision
computing, network and storage services with a single click

Infrastructure is elastic and scales automatically, expanding
and contracting on-demand to service peak usage periods

Infrastructure is a operating expenditure that charges only for
services when they are consumed



Kubernetes

- Phi-Beta-Kappa: Philsophia Biou
Kubernetes (Love of Wisdom Pilots
life)



kubernetes



“컨테이너”로 실제 서비스 & 운영까지

Kubernetes (쿠버네티스): 앱 개발 & 관리 전반에서 컨테이너를 오케스트레이션

다양하게 선택 & 사용

Kubernetes is in production for
global companies across industries¹

| | | |
|----------------|------------|---------|
| Capital One | eBay | SAP |
| New York Times | Pokémon Go | Spotify |

Vendor-neutral

A **variety of cloud providers**
offer robust Kubernetes support

| | |
|--------|---------|
| Azure | AWS |
| VMWare | Red Hat |

커뮤니티 지원

There's a **huge community** of active
contributors supporting Kubernetes³

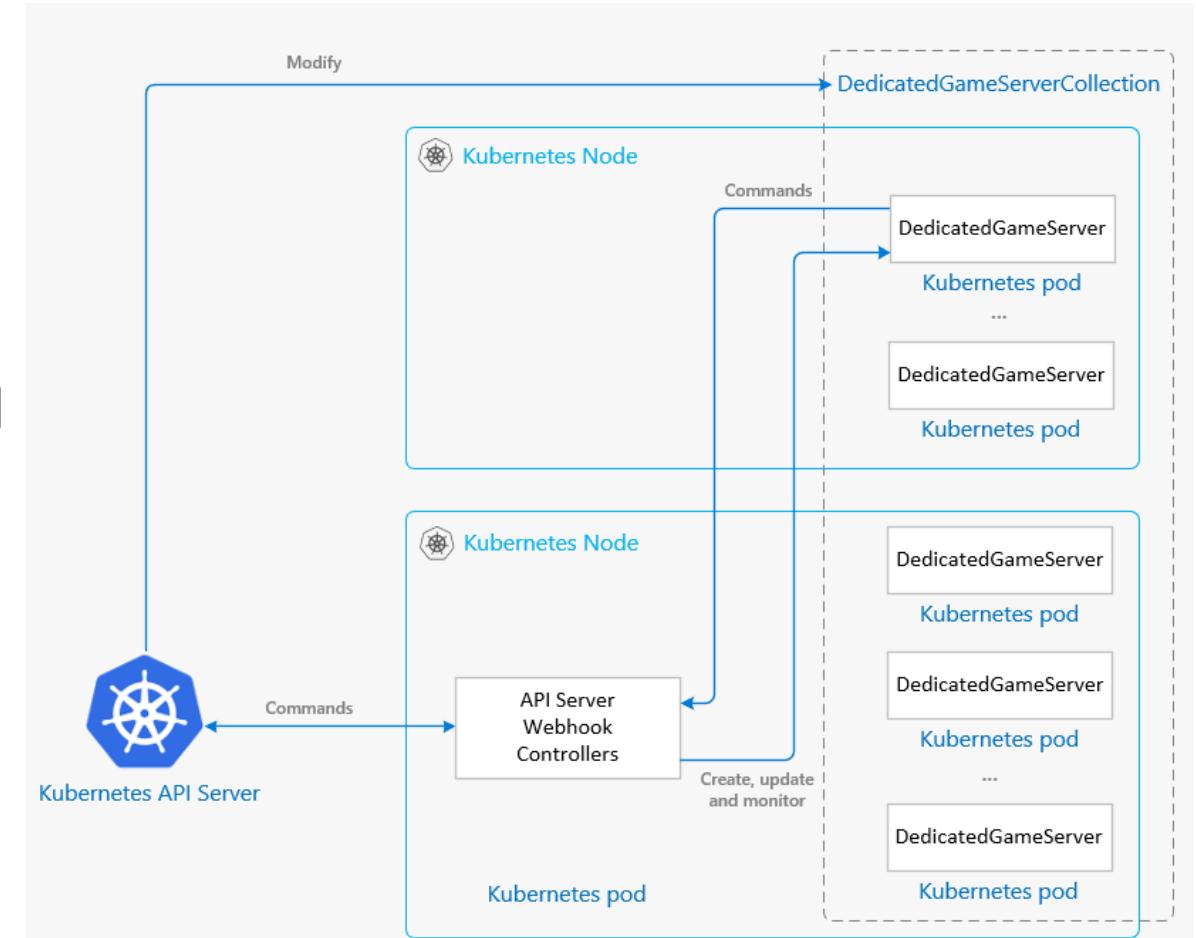
| | |
|--------------------------------|--------------------------------------|
| 24,000 contributors since 2016 | 1.1 million contributions since 2016 |
|--------------------------------|--------------------------------------|

¹Kubernetes.io. “Kubernetes User Case Studies.” ²CNCF. “Kubernetes Is First...” ³CNCF. Keynote address.

쿠버네티스를 사용하여 컨테이너화된 게임 서버 관리

리얼타임 멀티플레이를 위한 레퍼런스 아키텍처

- **DedicatedGameServer:** 게임 서버 자체를 나타내며, Pod 형태로 배포
- **DedicatedGameServerCollection:** 동일한 Pod 템플릿을 실행하고 컬렉션 내에서 확장/축소하기 위한 사용자 리소스 정의 (Custom Resource Definition)



<https://bit.ly/multi-player-game-server-reference-arch>

3. 데모: RPSLS – 마이크로서비스 아키텍처 게임과 쿠버네티스



가위바위보 도마뱀 스팍 (Rock, Paper, Scissors, Lizard, Spock, RPSLS)

Scissors cuts Paper

Paper covers Rock

Rock crushes Lizard

Lizard poisons Spock

Spock smashes Scissors

Scissors decapitates Lizard

Lizard eats Paper

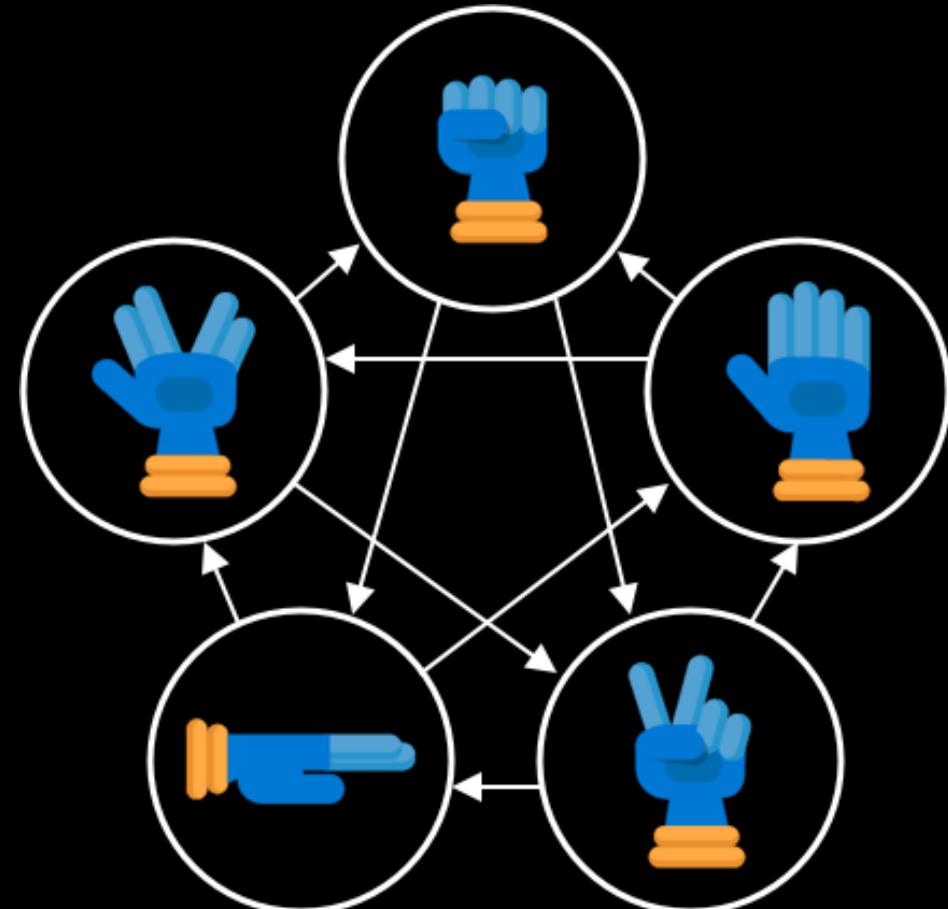
Paper disproves Spock

Spock vaporizes Rock

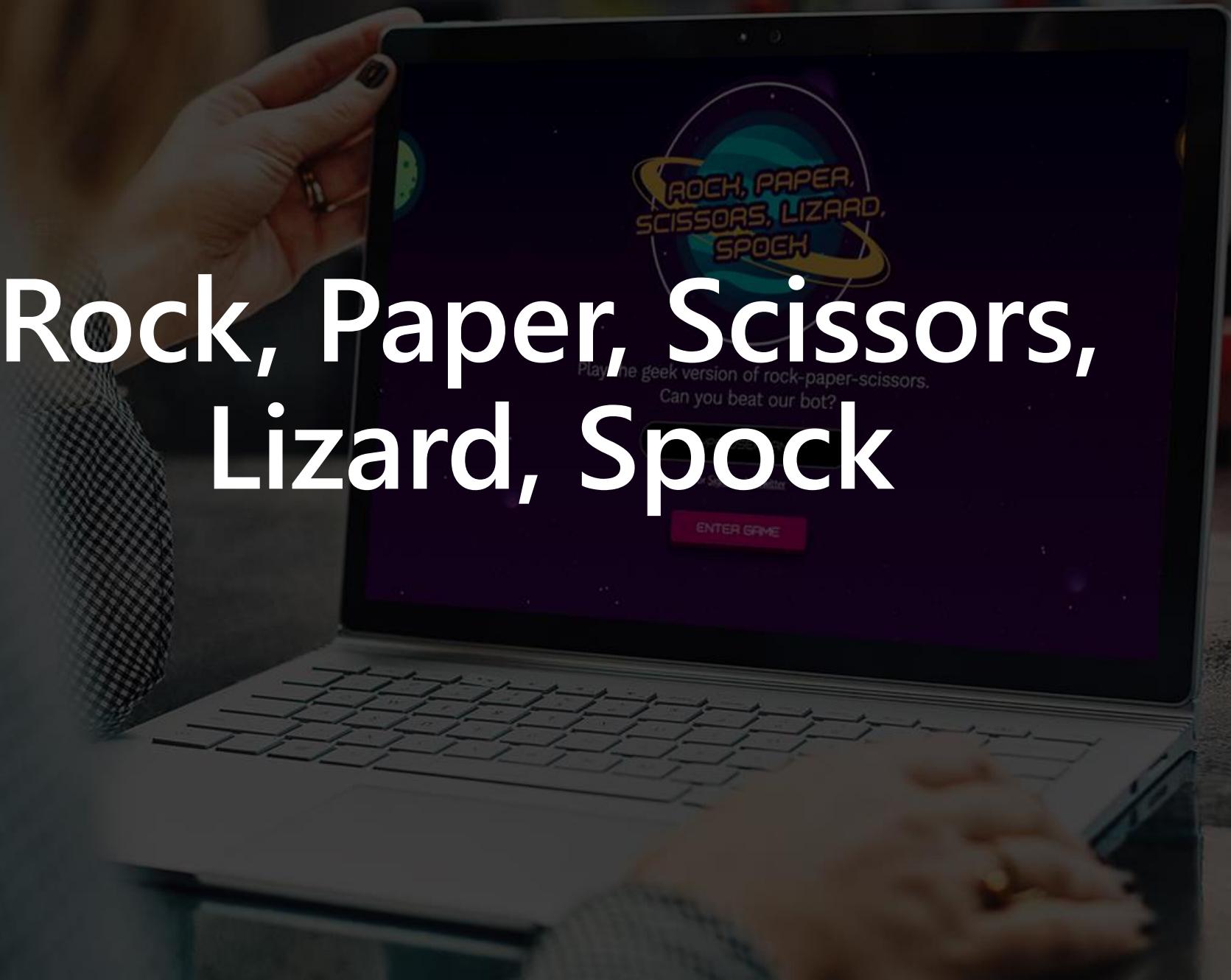
Rock crushes Scissors

RPSLS Created by Sam Kass and Karen Bryla

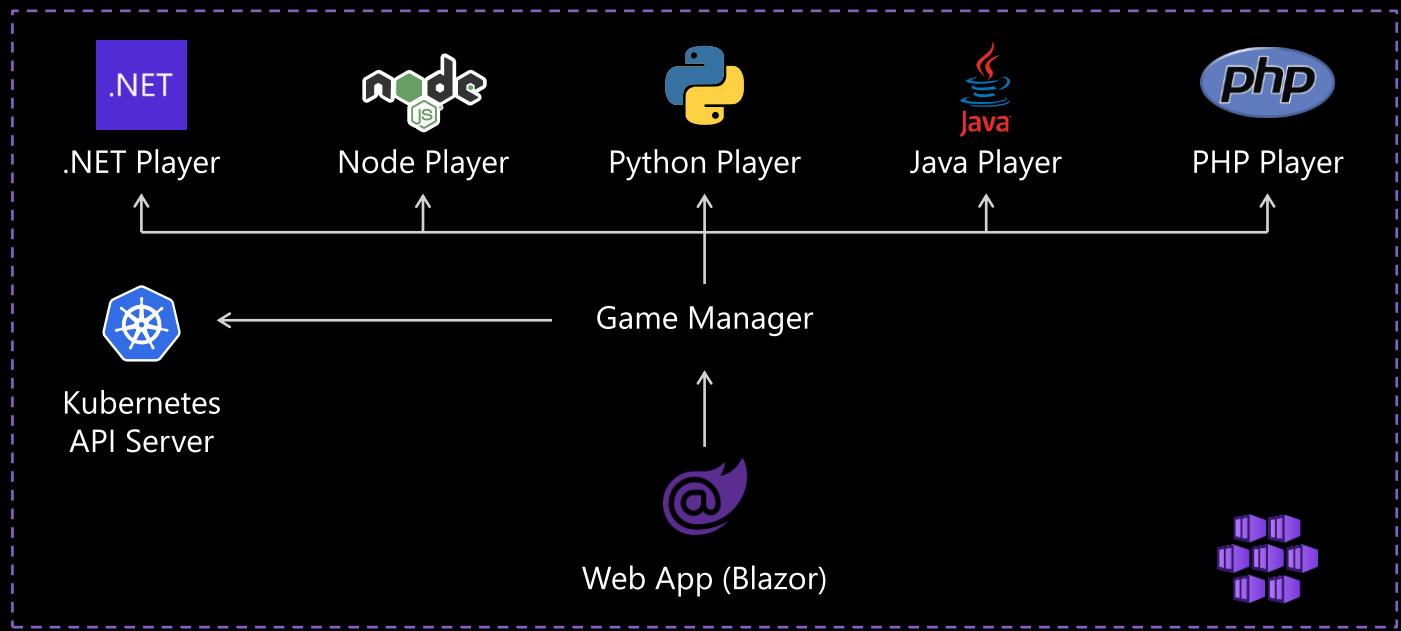
(빅뱅 이론 미드를 통해 더 잘 알려졌죠? ☺)



Rock, Paper, Scissors, Lizard, Spock

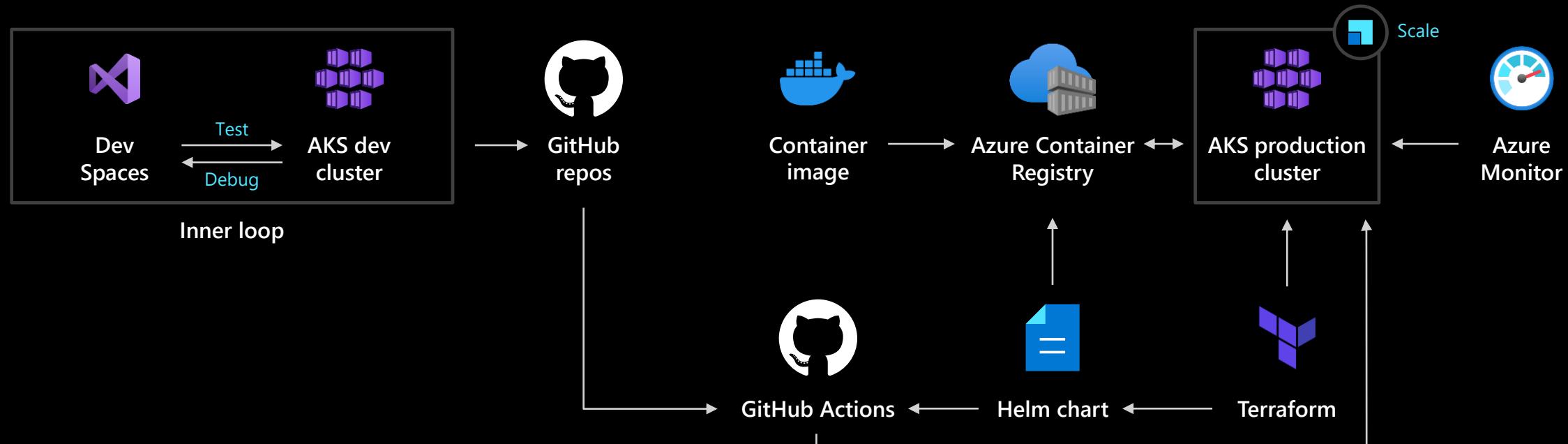


Rock, Paper, Scissors, Lizard, Spock



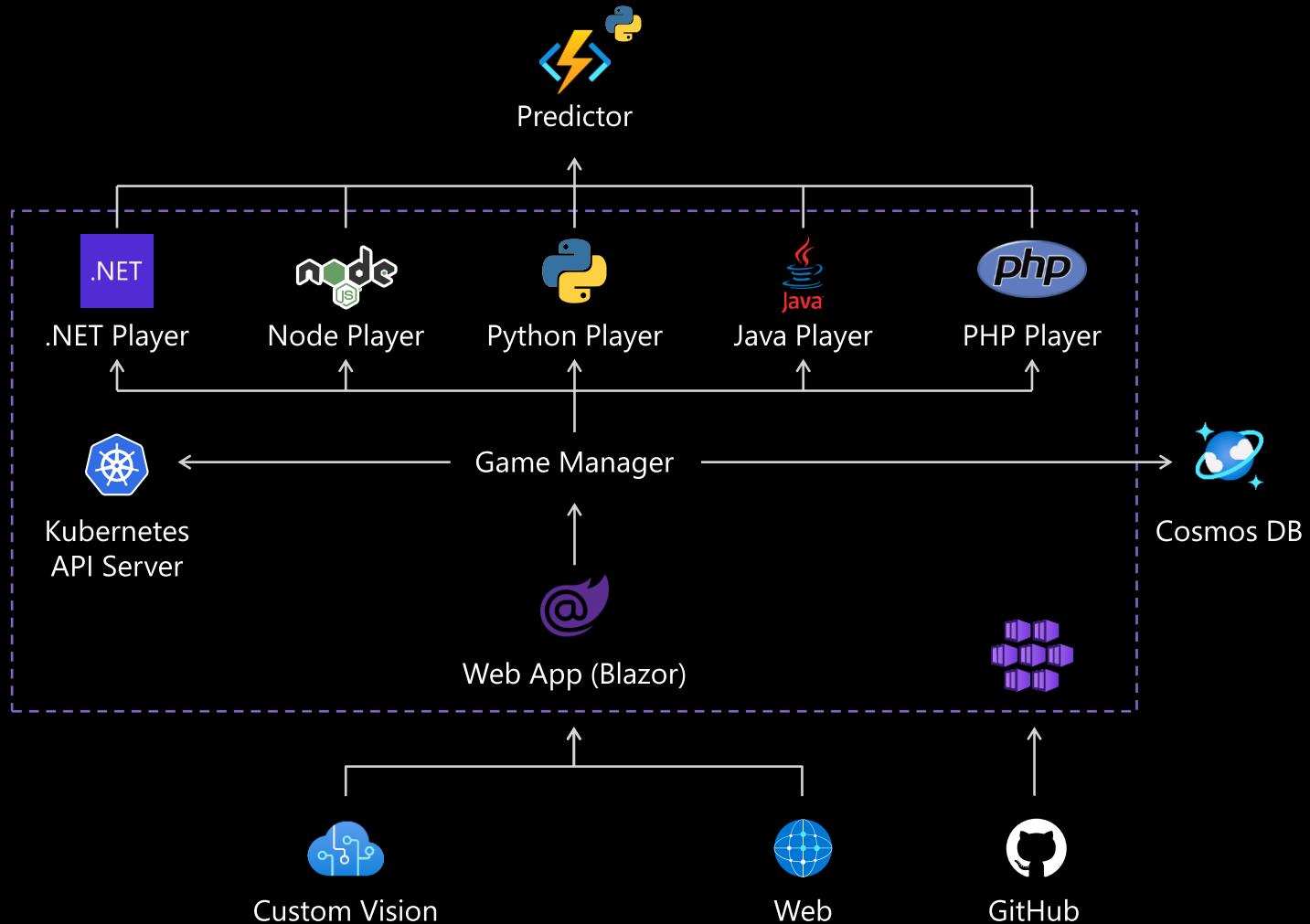
클라우드 네이티브 앱

マイクロ 서비스 アーキテクチャで開発されたコンテイナーアプリケーションを配布



Rock, Paper, Scissors, Lizard, Spock

- 전체 아키텍처
& 데모



감사합니다

THANK
YOU
very much!