

クラウドコンピューティング

基礎論

第2回

創造情報・小林克志

ikob@acm.org

Outline

1. Administrivia

2. Review polling

3. Cloud Computing (cont'd)

- Server Virtualization
- Virtualization with network / storage

I-REF trivia

- Men's restroom without ID is ONLY at 1st floor.
 - ID card security at 3rd - 5th floors, even during office hours.
- Return wall (floor) plug to the original position.
- Note: Creative Informatics students can access every floor.

Class Information

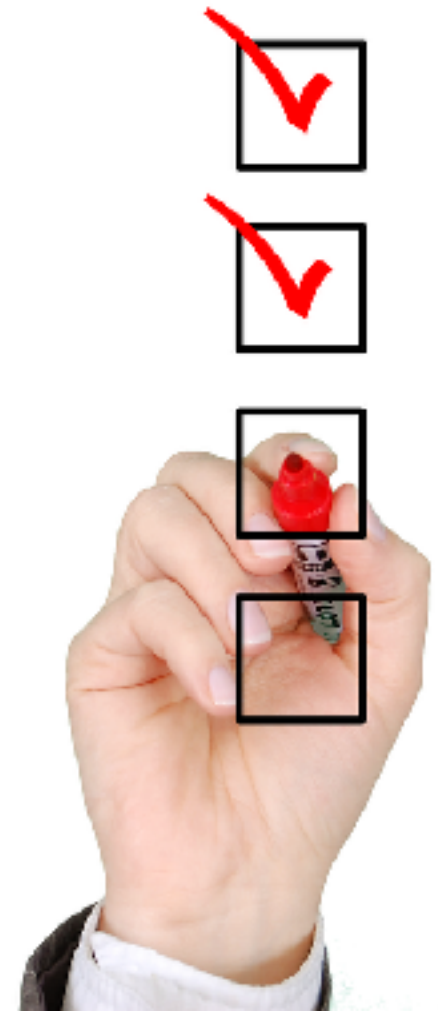
- Provided by Web page:

<http://www.ci.i.u-tokyo.ac.jp/~ikob/lecture/2018-fcloud>

- Includes report submissions/roll calls/materials.
- An authorization is required for access:
User: cloud
Pass: cloud!2018

Grade Policy

- Course comprises lectures (2/3) and exercises (1/3).
- Grade by achievements of :
 - Quiz and/or homework at each class
 - Quiz due during the class period, instead of roll call.
 - Homework due at the two days before the next class (or next Tuesday).
 - Exercises
 - Final report instead of exam
Will submit review report for a paper on the reading list.
Reading list will be given during the course.



海賊版サイト遮断が波紋 著作権保護、歓迎の声 通信の秘密に抵触懸念も

2018/4/25付 | 日本経済新聞 朝刊

NTTグループによる「海賊版サイト」に対する接続遮断（ブロッキング）が波紋を広げている。コンテンツ育成の観点からは、悪質な著作権侵害が見受けられるサイトへの規制を歓迎する声上がる。一方で、政府が指定したサイトへの遮断に安易に応じる行為を疑問視する見方もある。インターネット時代のコンテンツ管理のあり方が問われている。

ブロッキングはNTTグループでネット接続を手掛ける3社が決めた。対象に挙げられたのが「漫画村」と「Anitube」、「Miomio」の3サイトだ。

■被害額4000億円の指摘 数ある海賊版サイトからこの3つを選んだのは、13日に政府の知的財産戦略本部がまとめた「緊急対策」で名指しされたため。その資料はコンテンツ海外流通促進機構の推計として、3サイト合計の被害額は4000億円以上と指摘する。

知財本部は著作権の侵害が疑われることを理由に「ブロッキングを行うことが適当」と結論づけた。出版社などコンテンツの提供側は著作権が保護されるという点で歓迎する。講談社は「現状を放置すれば日本のコンテンツ産業を根本から破壊する」と主張する。

プロバイダーが海賊版サイトへの接続を遮断するには、ユーザーがどのサイトにアクセスしようとしているかを逐一チェックする必要がある。海賊版を見ようとしている人だけでなく、全てのユーザーの通信内容を把握しなければならない。

法学者らは、プロバイダーが接続遮断する行為は、憲法21条が保障する「通信の秘密」に抵触する恐れがあると懸念を示す。さらに電気通信事業法は通信の秘密の侵害を罰則を設けて禁じる。

これに対し、知財本部は刑法に基づく「緊急避難」の要件を満たす場合は通信の秘密に

関して「違法性が阻却される」と明言。「緊急避難」が認められるには、(1)現在の危難 (2)他に手段がない（補充性）(3)その措置によって守られる利益の方が犠牲にする利益よりも大きい（法益権衡）——という3つの要件が必要とされる。今回のケースは一時的な緊急処置だから検閲には、当たらないという立場だ。

■40カ国以上でブロッキング 海外ではブロッキングは韓国や英国、豪州など世界40カ国以上で実施している。一方、日本では法整備は遅れており、海賊版サイトの排除は通信事業者の自主的な対応に委ねてきた状況だ。

菅義偉官房長官は24日の記者会見で海賊版サイト対策の法整備を急ぐ考えを示し、19年の通常国会への関連法案の提出を検討している。国内のプロバイダー（接続業者）によるブロッキングに法的根拠を与え、作者の利益侵害や日本の出版文化の衰退を防ぐ狙いがある。

政府の知的財産戦略本部が例示した3サイトは一部は既に他サイトに移行したように、法整備したとしてもいたちごっこになる可能性はある。だが、海賊版サイトは広告収入が細るほか、サイトの閉鎖・移行のコストも業者にとって負担になる。「立法措置で、ビジネスとして割に合わない状況を作り出せる」（総務省）という。

ネットの発展で近年は既存の産業の垣根を越えたサービスに法整備が追いつかない事態が相次ぐ。「通信の秘密」は、通信が1対1のコミュニケーション手段だった時代に、傍受などの人権侵害を防ぐ目的が発端だったが、ネットのような1対多、多対多の時代にそのまま当てはまるかどうかは議論がある。

そうした時代に著作権と通信の秘密という、いずれも譲れない権利保護をどう両立させるか。ネット上にはフェイスブックが批判にさらされた偽ニュースや、フリーマーケットアプリ、メルカリ上の違法出品など有害・違法なコンテンツが流通している。通信会社などが傍観できなくなっているのも確かだ。

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接続遮断の対象に挙げられた「漫画村」

US 音楽産業の例



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TIME

Thursday, Aug. 05, 2010

Colleges Ban Napster

By Nate Rawlings

At the turn of this century, there were pretty much two ways to get music: watch MTV (when it played music) or shell out nearly 20 bucks for a CD. Enter Shawn Fanning, a Northeastern University student who invented Napster, a computer program that allowed users to share songs over the Internet. Music was suddenly everywhere, and it was all free. In one of the first great battles over intellectual property in the Internet era, mega-metal band Metallica sued Napster for copyright infringement. But college students had more immediate concerns. Colleges began banning Napster, because the website's file sharing used up all available bandwidth. CNN reported in 2001 that 34% of U.S. colleges and universities had banned Napster, and in the summer of 2001, free Napster came to an end. The party didn't die, however; knockoffs such as Bearshare and Limewire were slow and clumsy, but the music was still free. The 2008 Digital Millennium Copyright Act banned all illegal file sharing and levied fines of up to \$30,000 for each downloaded song. Schools then installed blocking software, ending file sharing's 10-year run.

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http://content.time.com/time/specials/packages/article/0,28804,2008434_2008436_2008498,00.html

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US 音楽産業の例(続き)

News and Notes on 2017 RIAA Revenue Statistics

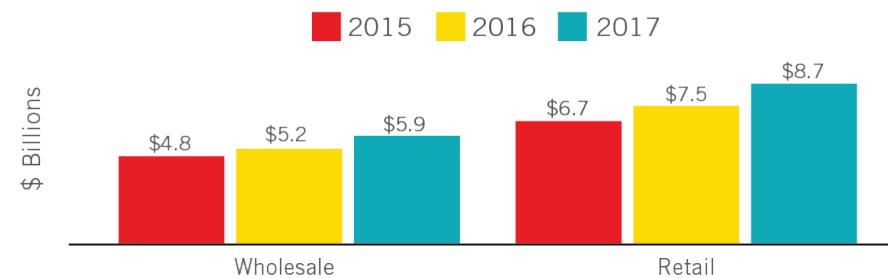
Joshua P. Friedlander | Senior Vice President, Strategic Data Analysis, RIAA

In 2017 revenues from recorded music in the United States increased 16.5% at estimated retail value to \$8.7 billion, continuing the growth from the previous year. At wholesale, revenues grew 12.6% to \$5.9 billion. Similar to 2016, these increases came primarily from growth in paid music subscriptions to services like Spotify, Amazon, Tidal, AppleMusic, Pandora and others, which grew by more than 50%. This is the first time since 1999 that U.S. music revenues grew materially for two years in a row. At \$8.7 billion, the industry has taken a decade to return to the same overall revenue level as 2008, and is still 40% below peak levels as the growth from streaming has been offset by continued declines in revenues from both physical and digital unit based sales.

Figure 1

U.S. Music Industry Revenues

Source: RIAA



STREAMING

Streaming music platforms accounted for almost 2/3rd of total U.S. music industry revenues in 2017, and contributed nearly all of the growth. The streaming category includes revenues from premium subscription services, streaming radio services including those revenues distributed by SoundExchange (like Pandora, SiriusXM, and other Internet radio), and ad-supported on-demand streaming services (such as YouTube, Vevo, and ad-supported Spotify).

Total revenues from streaming platforms were up 43% to \$5.7 billion, and in 2017 made up 65% of total industry revenues.

Figure 3

Streaming Music Revenues

Source: RIAA

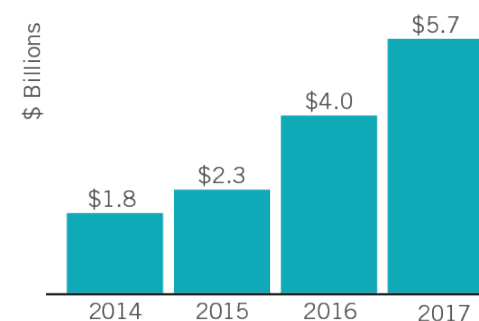
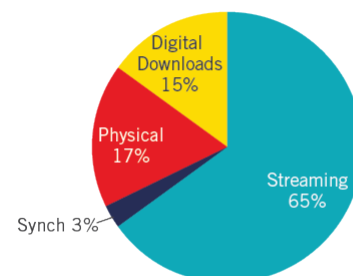


Figure 2

U.S. Music Industry Revenues 2017

Source: RIAA



US 音楽産業の例(続き)

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TIME

Friday, Oct. 12, 2007

Behind the Battle for Madonna

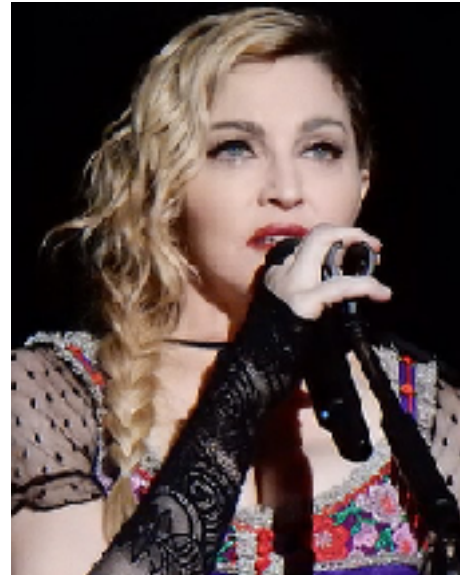
By Kristina Dell

At a time when lagging CD sales and music piracy have made the album a mere accessory to touring, merchandising and licensing, it's no wonder that ailing record labels like Warner Music Group have been exploring ways to get a piece of that much more lucrative side of the business. So just imagine how they must feel now that Live Nation, the world's largest concert promoter, is close to stealing away pop music icon Madonna for a cool \$120 million in cash and stock.

The 10-year deal, first reported by the *Wall Street Journal*, would include the rights to sell three studio albums, promote Madonna's concerts and sell licensing name rights and merchandise, meaning a company that has never represented an artist before would suddenly be overall talent agent to one of the world's biggest music acts. If it is consummated — and both Warner Music and Live Nation refused requests to comment on the deal — it would be just the latest example of the increasingly prevalent so-called 360-degree deals that have concert promoters, record labels, ticketing agencies and management firms all invading each other's turf.

The hefty potential payout comes on the heels of a similarly bold move by Live Nation over the summer. In August, the king of concerts decided not to renew the contract that gave Ticketmaster exclusive ticketing distribution for most of Live Nation's 29,000 annual events, a loss that will rob the ticketing giant of about 20% of its sales. Instead, Live Nation is pumping up its own in-house ticket distribution arm, already the third largest in the world, which gives it a direct link to the music fans attending its shows. Not to be outdone, Ticketmaster significantly increased its stake in Front Line Management, an agency that represents such acts as Christina Aguilera, Jimmy Buffett and Aerosmith, when rumors swirled that Live Nation wouldn't renew its contract. Warner, for its part, has been looking around for partners, potentially hooking up with none other than IAC/ InterActive Corp, Ticketmaster's parent, as a way to counter Live Nation's proposal to manage all of Madonna's concerts and album releases. And earlier this summer Warner Music formed a joint venture with Violator Management, a firm that negotiates roles for rappers in films, advertisements, video games and TV programs.

The wave of consolidation in the industry may make sense for the suits, but it's not clear that it benefits the artists. Some acts like Radiohead and Prince have recently bypassed labels — and the tremendous cut of profits they typically take — altogether. Last week Radiohead released its new album, "In Rainbows,"



Wikipedia より

online with a "pay what you want" model. Similarly, Prince gave away 3 million shrink-wrapped copies of his new album last year in London's Sunday Mail newspaper.

"I wouldn't bundle all these rights into one cross-collateralized company," argues Randy Phillips, who manages Lionel Richie and is President and CEO of AEG Live, the second largest concert promoter after Live Nation. Phillips says Warner Music contacted him a few months ago to be a potential partner when they were worried about Madonna being stolen away, though the two didn't ultimately make a deal. "I think an artist can fare better with direct relationships. It takes different skill sets to maximize revenue in the different areas and the artist cheats herself by trying to put it all together."

Others see it differently. "It benefits the artist by having one company do it all because the agendas are aligned," says Jon Cohen, co-president of Cornerstone Promotion, which does music marketing. Regardless, most everybody agrees this particular deal would be a no-brainer for Madonna. "She is 49 years old and this is enormous risk mitigation," says Jim McCarthy, CEO of Goldstar Events, a ticketing distributor.

Despite all the speculation, the deal is not even finalized. "I wouldn't totally count out Warner Music in terms of keeping her," says Phillips.

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Find this article at:

<http://content.time.com/time/business/article/0,8599,1671179,00.html>

Course Outline

- 1.Administrivia
- 2.Cloud computing
- 3.Service reliability
- 4.Distributed data stores
- 5.Global services
- 6.Datacenter networkings (1)
- 7.Datacenter networkings (2)
- 8.Network performance
- 9.User experiences
- 10.Network latencies
- 11.Advanced topics

Outline

1. Administravia

2. Review polling

3. Cloud Computing (cont'd)

- Server Virtualization
- Virtualization with network / storage

Review Polling

Cloud Computing : NIST definition

“Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models.”

NIST
National Institute of
Standards and Technology
U.S. Department of Commerce

Special Publication 800-145

The NIST Definition of Cloud Computing

Recommendations of the National Institute
of Standards and Technology

Peter Mell
Timothy Grance

Cloud : Five essential characteristics

1. On-demand Self-service

- provision computing capabilities without requiring human interaction

2. Broad network access

3. Resource pooling

- location independence

4. Rapid elasticity

- provisioned and released, to scale rapidly outward and inward

5. Measured service

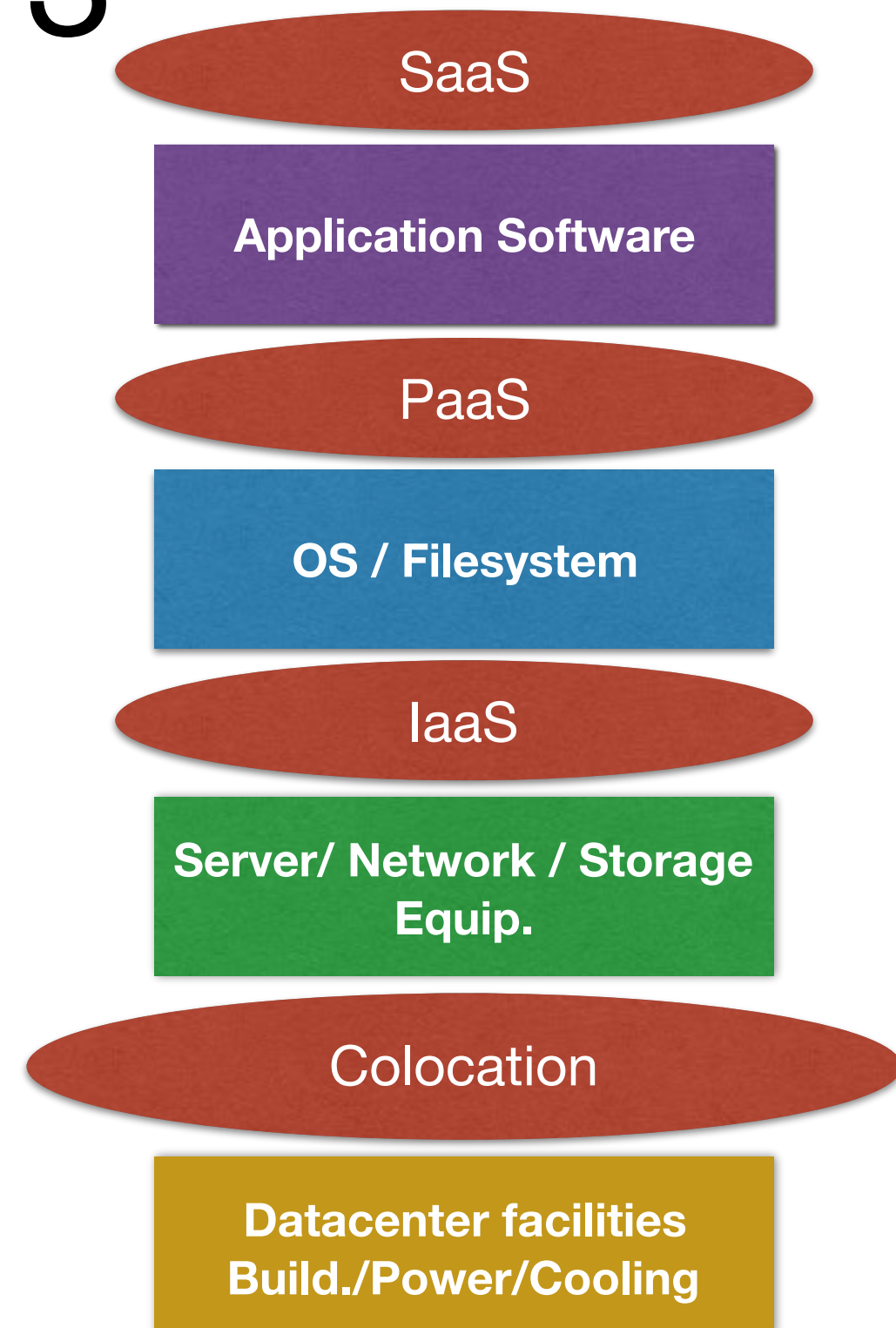
- metering capability, e.g., storage, processing, memory, network bandwidth, user-accounts

Cloud : Three service models 1/3

1. Software as a Service (SaaS) :

“The capability provided to the consumer is to use the provider’s applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user- specific application configuration settings.”

- e.g., Google Docs, Office 365, Salesforce CRM, SAP ERP



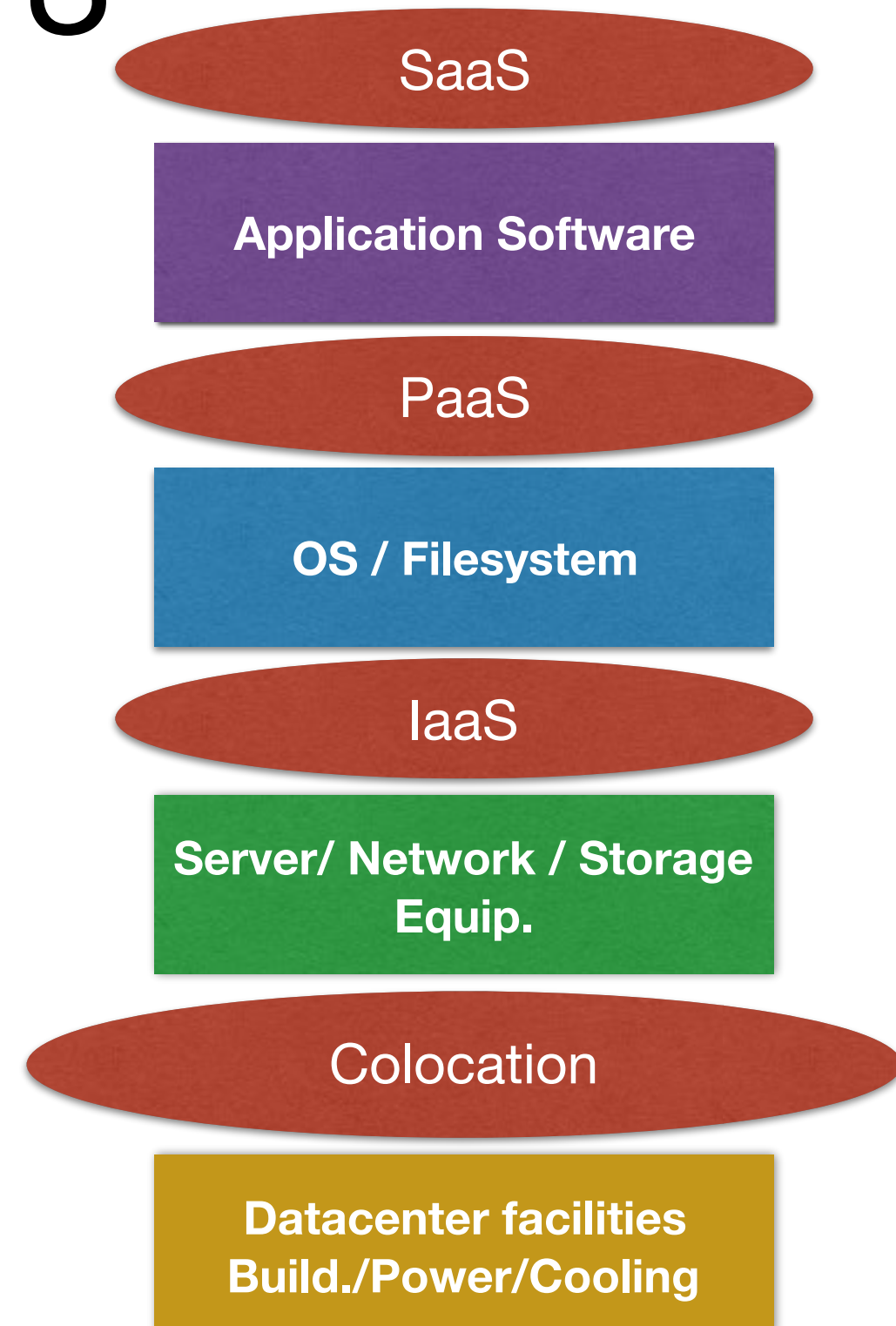
Cloud : Three service models 2/3

2. Platform as a Service (PaaS)

“ The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.”

- e.g., Google App Engine, Amazon Elastic Beans Talk, Heroku

Mell, Peter, and Tim Grance. "The NIST definition of cloud computing." (2011).



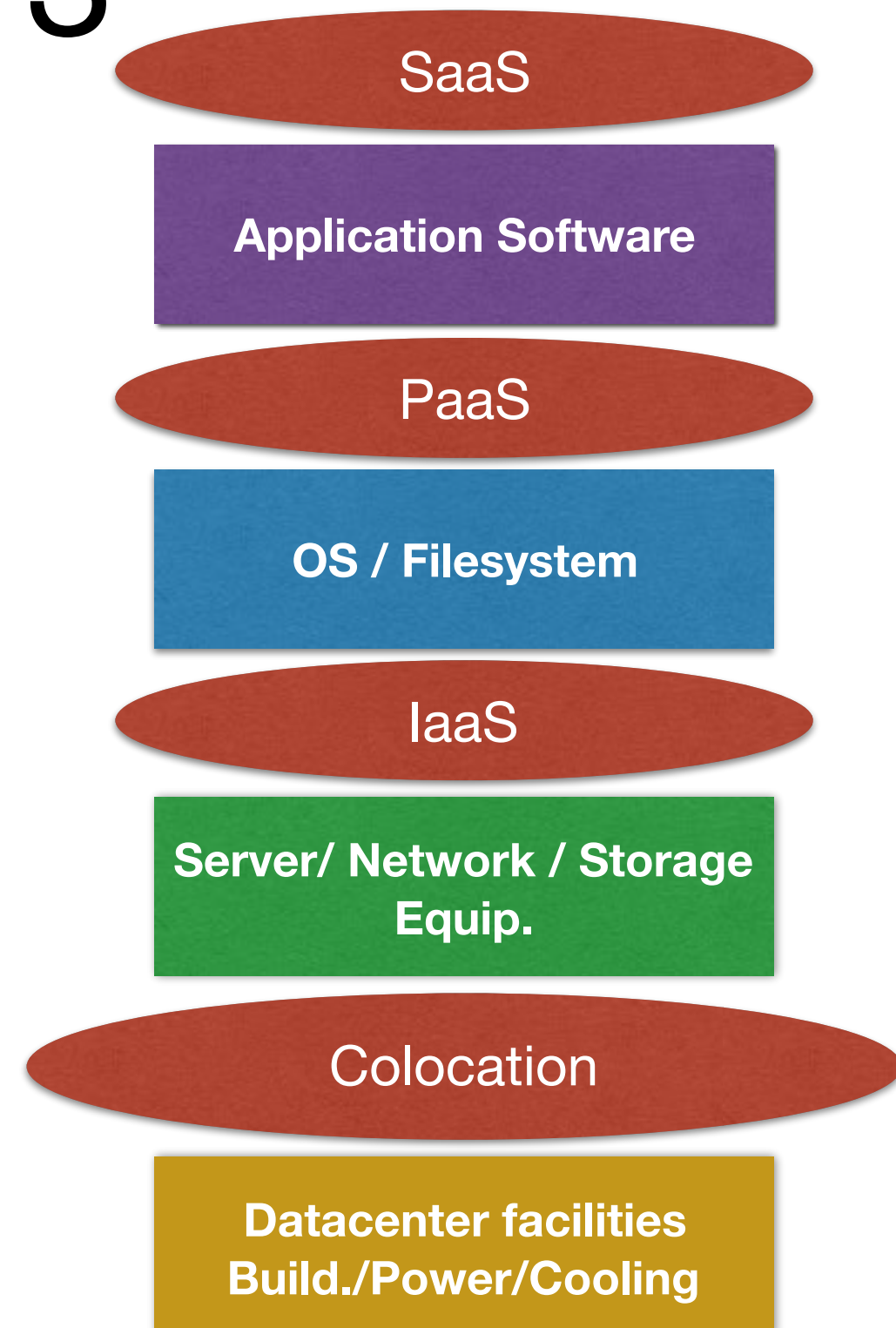
Cloud : Three service models 3/3

3. Infrastructure as a Service (IaaS)

“The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components (e.g., host firewalls).”

- e.g., Amazon EC2, Microsoft Azure

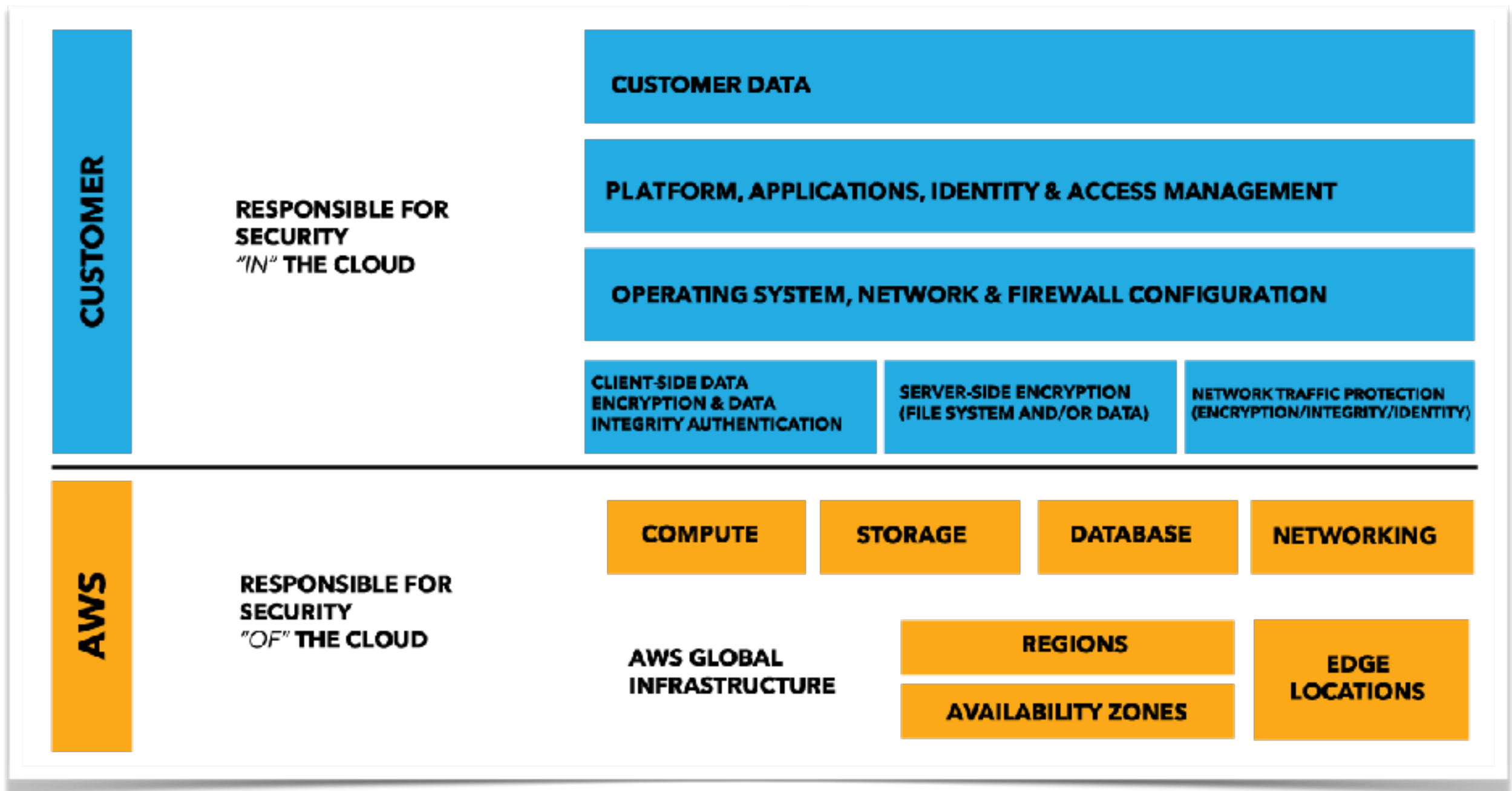
Mell, Peter, and Tim Grance. "The NIST definition of cloud computing." (2011).



Cloud service models

	customer effort	# users / HW	revenue model	Implementations
SaaS	Application setting/ Using API	?	Charge to user, Advertisement,...	Rekognition, Route53
PaaS	Control deployed application	< 100	Charge per container, storage	EC2 Container Service (ECS)
IaaS	OS / Application / Limited network	# of CPU cores	Charge per VM	AWS EC2
Server Hosting	OS / Application / Server / Network	1	Charge per Server	AWS EC2 (dedicated server)

Shared Responsibility Model of AWS



Four deployment models

1. Private cloud

- Exclusive use by a single organization or business unit.
- Either On-/Off- premiss



2. Community cloud

- Exclusive use by a specific community, e.g., government.
- Either On-/Off- premiss

3. Public cloud

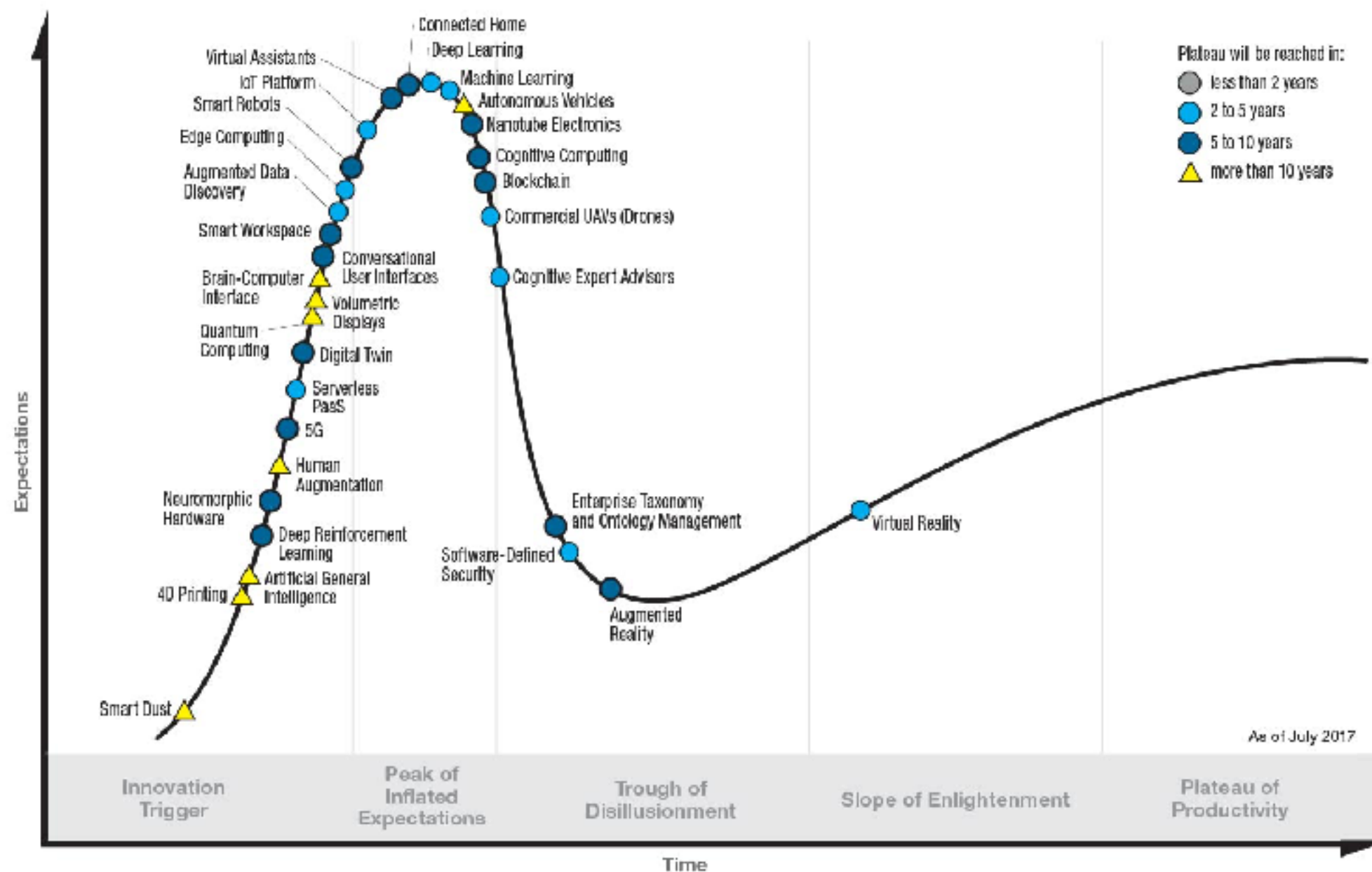
- Open use, Off- premiss.

4. Hybrid cloud



Shared / Dedicated server space in a DC floor

Gartner **Hype Cycle** for Emerging Technologies, 2017



gartner.com/SmarterWithGartner

Source: Gartner (July 2017)

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Gartner

Today's quiz

- What topic in the Gartner's Hype-Cycle 2016 has the strongest relation to your research interest ?
- Submit from course web site until the end of the class.

Outline

1. Administrivia

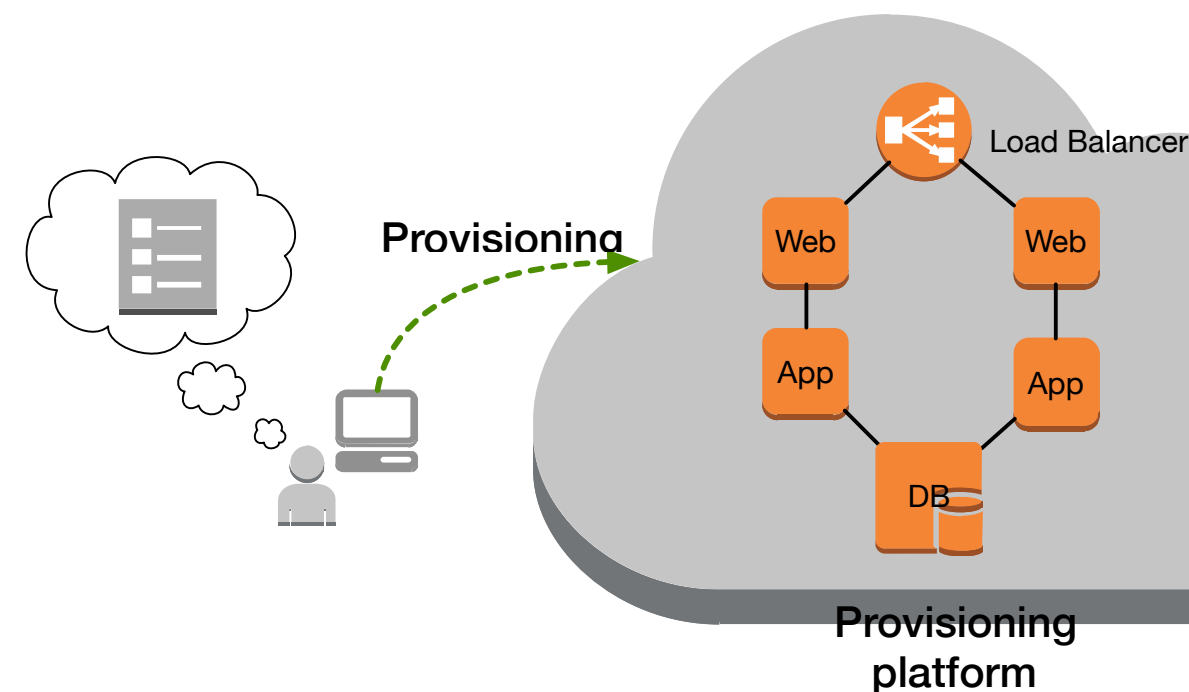
2. Review polling

3. Cloud Computing (cont'd)

- Server Virtualization
- Virtualization with network / storage

Cloud computing & virtualization

- PaaS / IaaS are comprised of platforms which support service deployment (or provisioning), and of its manager.
- “Five Essential characteristics” in the NIST definition.
- Virtualization technologies realize such services.

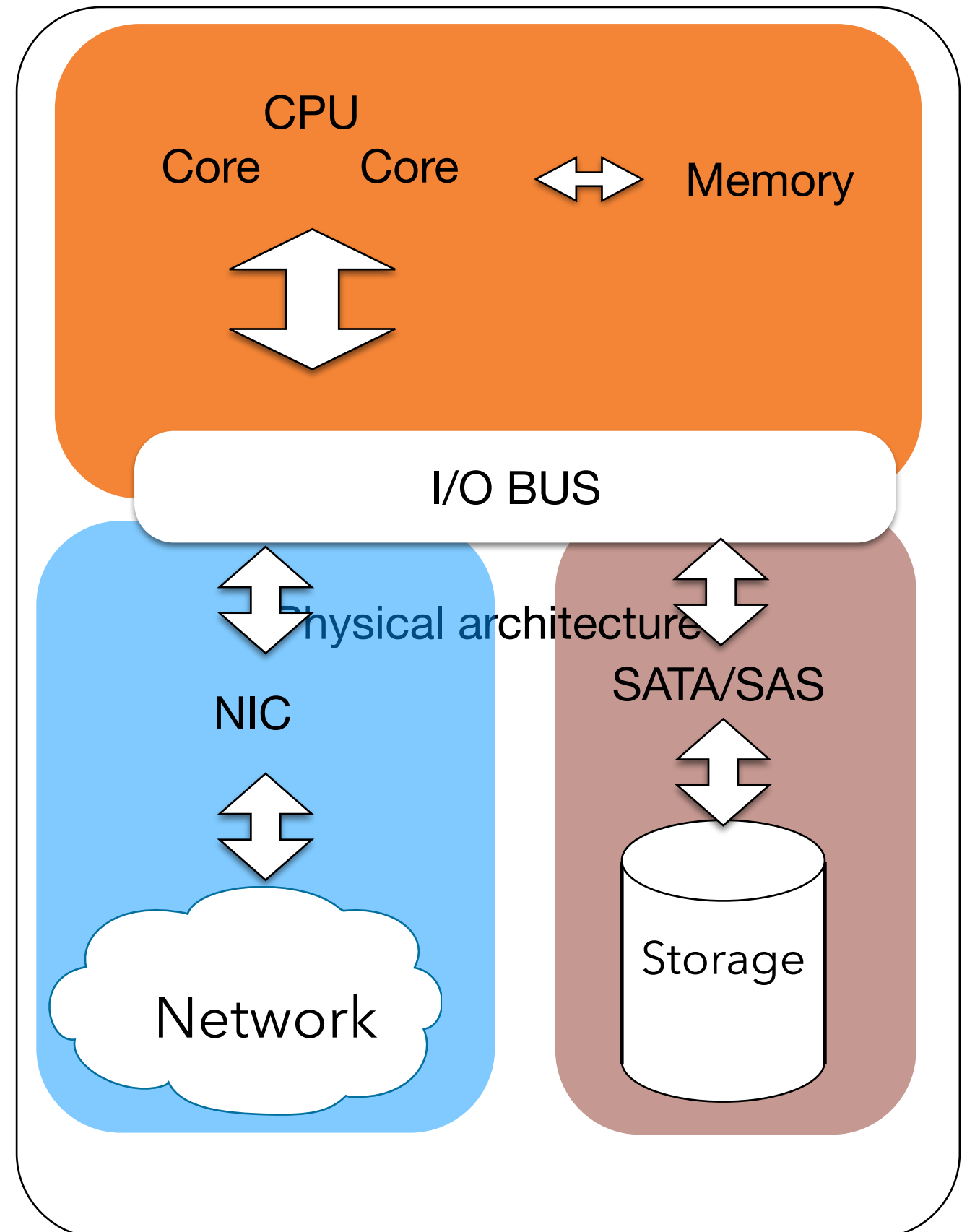


Virtualize various computer HW resources

- CPU / Core / Memory
- Hypervisor
- Container manager

- Network
- Virtual NIC + Virtual LAN

- Storage
- Disk image, RAID, Storage Area Network (SAN), Distributed File System



Cloud service models

	customer effort	# users / HW	revenue model	Implementations
SaaS	Application setting/ Using API	?	Charge to user, Advertisement,...	Rekognition, Route53
PaaS	Control deployed application	< 100	Charge per container, storage	EC2 Container Service (ECS)
IaaS	OS / Application / Limited network	# of CPU cores	Charge per VM	AWS EC2
Server Hosting	OS / Application / Server / Network	1	Charge per Server	AWS EC2 (dedicated server)

Virtualization for IaaS/PaaS

- Multi-tenancy : Cost reduction with sharing hardwares
 - Consolidation / Aggregation / Time division
- Privacy / Security : Isolate customers
- Performance:
 - Guarantee resources : CPU/Core, Memory, network BW, Storage capacity / I/O
- Agile elasticity:
 - Resource pool, Service deployment / release

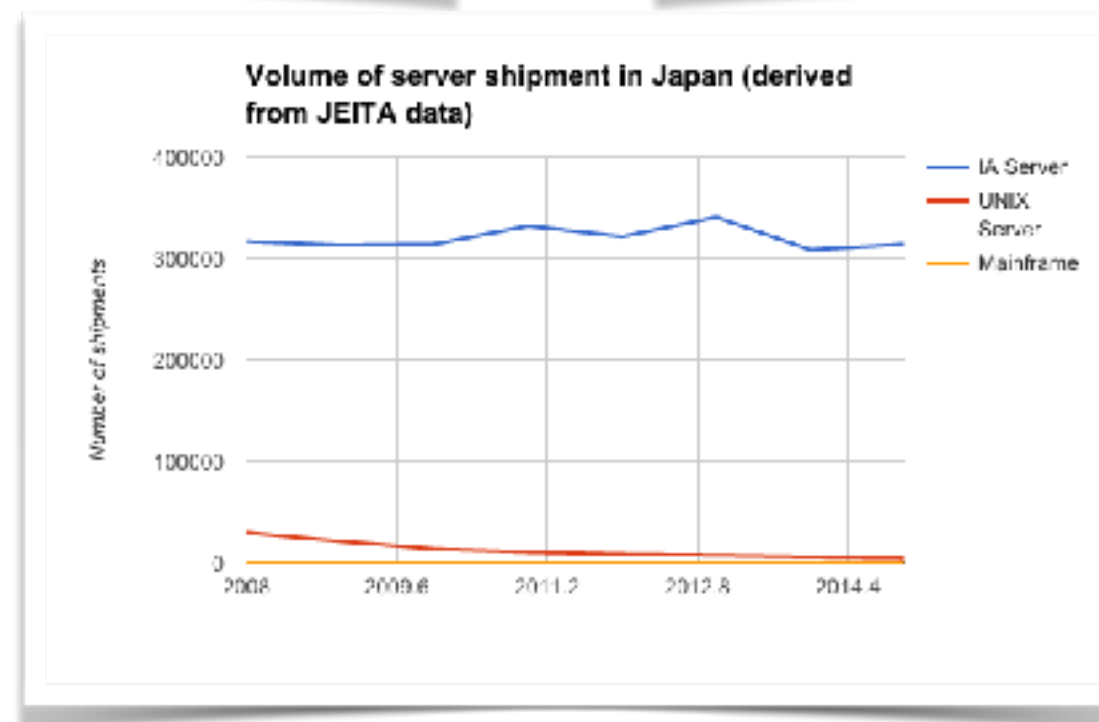
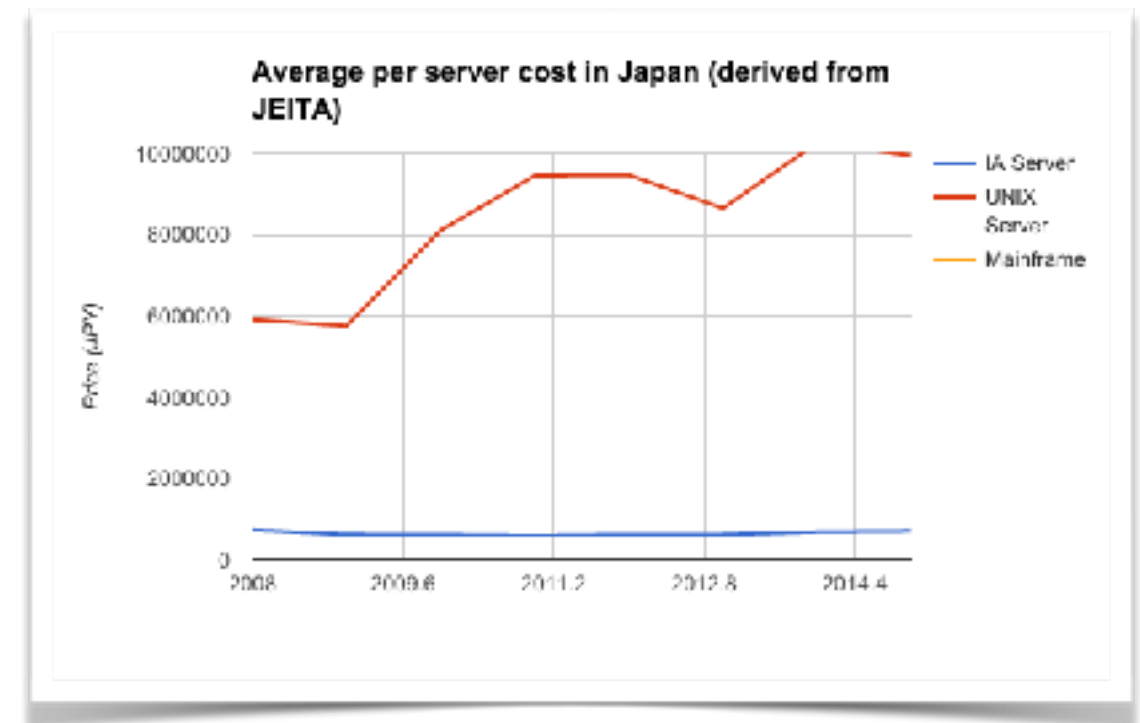
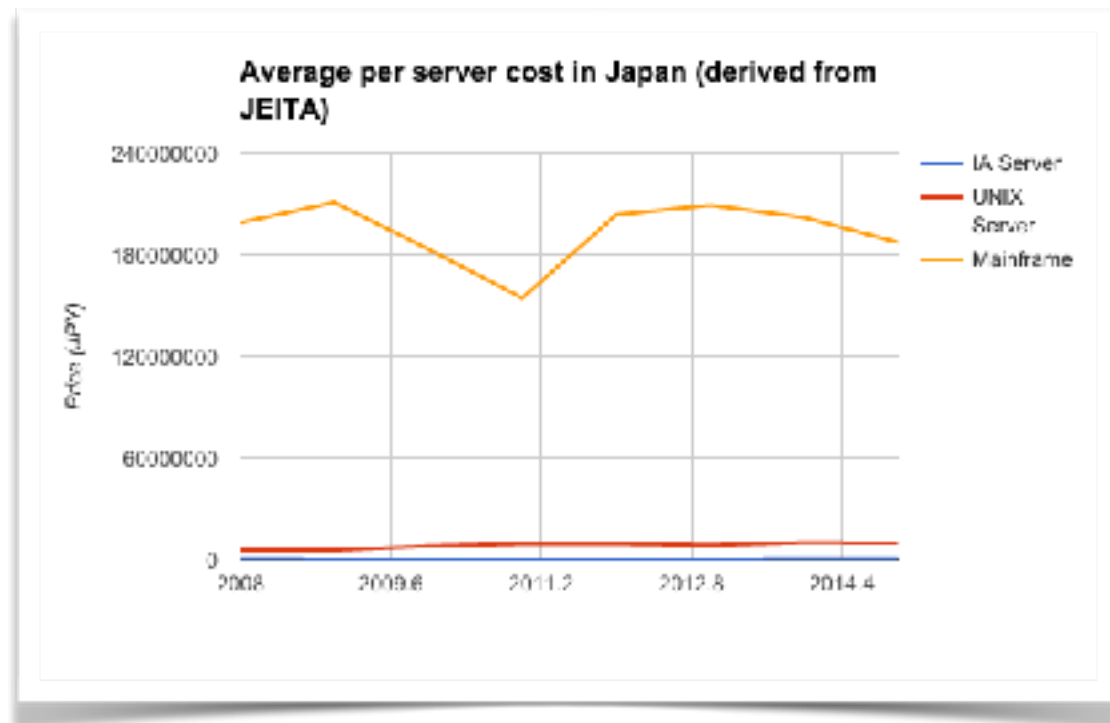
Server Virtualization : Background

- Thanks to Moore's law, HW server performance is growing, e.g., # cores, memory capacity, storage capacity, Network BW.
- However,
 - \$\$\$ for a HW server stays the same level (or increasing)
 - HW performance is too much for most use cases.
- Consolidate services within one HW platform.

Server Virtualization

- Pros:
 - Cost reduction : # of HW
 - power, space, operation & management (OAM)
 - Migration : Able to deploy OS/applications to other HW
 - R&D, Education : OS development & debugging, security sandboxing
- Cons:
 - Costs and performance penalty such with Hypervisor.

Why server HW cost is unchanged ?



IaaS

(Server) Virtualization Technologies

- Virtual Machine (for IaaS):
 - Provides emulated HWs to run various OSs.
- OS virtualization (for PaaS):
 - Provides OS platforms to run various applications.

Note: Virtualization had appeared in the 1960s on IBM platform.

Virtual Machine (VM)

- VM Hypervisor provides emulated HWs.
 - Para-virtualization : require modified OSs.
 - Is over at x86 platform after hardware virtualization.
 - Full-virtualization : run unmodified guest OSs.
 - Hardware Virtualization : a type of full-virtualization with special CPU support for virtualization, such as, Intel VT-x.
- Hypervisor types:
 - Type1: Hypervisor runs as an process of underlying OS, such as VMware Player, Oracle VirtualBox.
 - Type2: Hypervisor runs without underlying OS, such as VMware ESXi, MS Hyper-V.

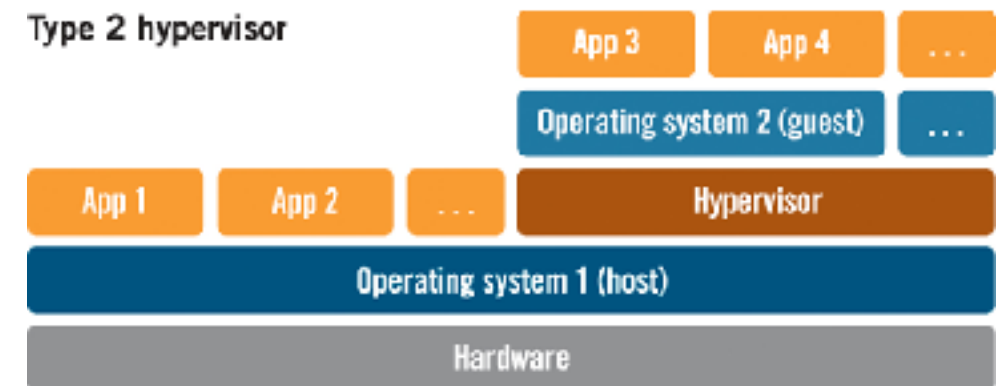


Figure 1. A Type 2 hypervisor runs as an application on a host operating system.

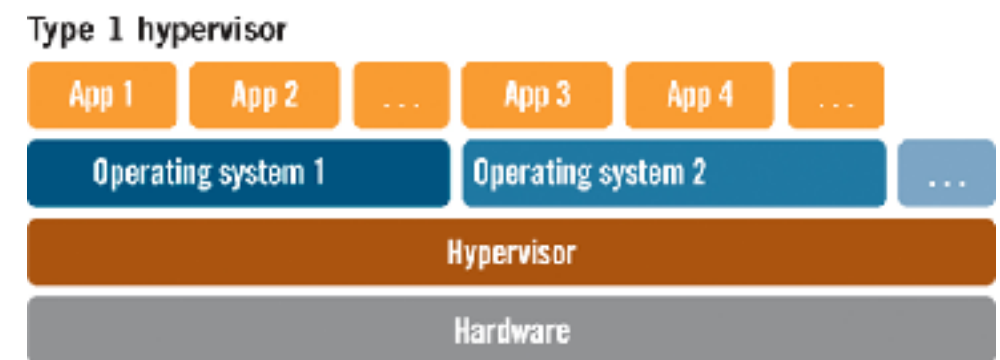


Figure 2. A Type 1 or bare-metal hypervisor sits directly on the host hardware.

<https://www.virtzone.net/the-difference-between-a-type-2-hypervisor-and-a-type-1-hypervisor/>

Virtual Machine (VM) (contd.)

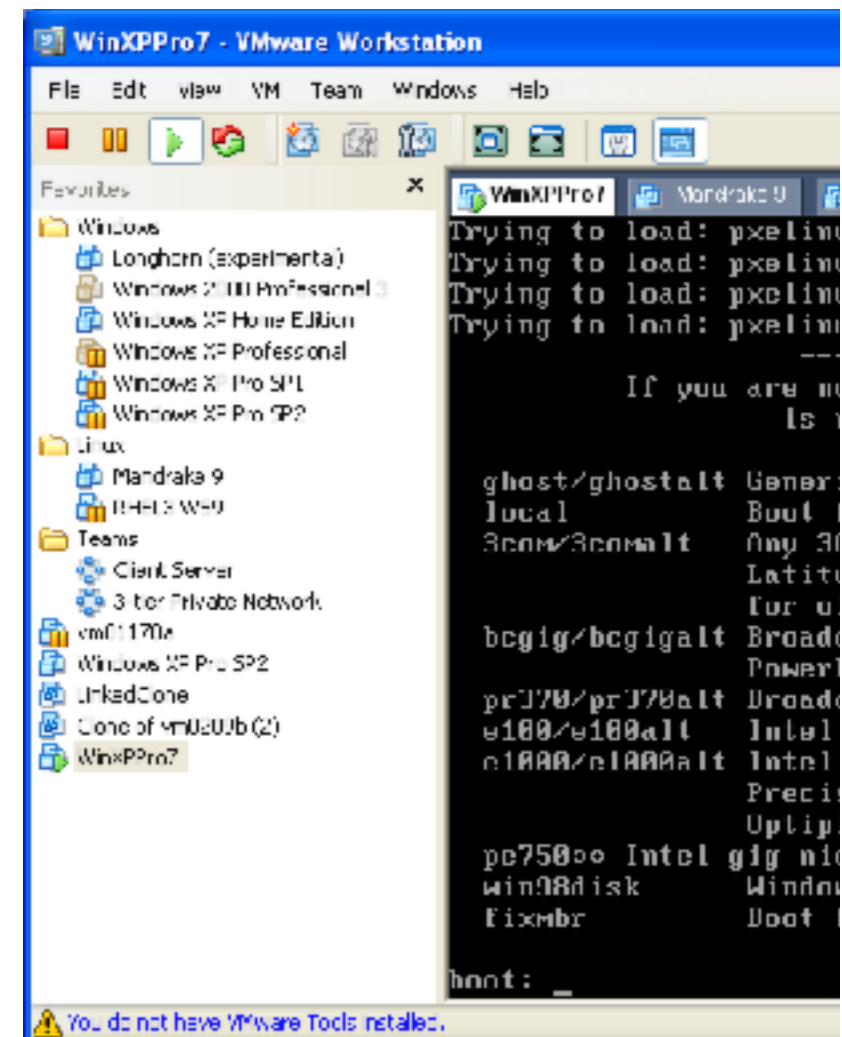
- Can accommodate multiple systems without changing not only applications, but also libraries and OS.
- Avoid troubles due to version dependencies of libraries, OSs.
- Legacy system consolidation is an important use-case.

Tutorials for VM technology:

www.ieice.org/~nv/12-nv20120302-kohno.pptx

(Japanese)

http://www.hotchips.org/wp-content/uploads/hc_archives/hc11/3_Tue/hc99.s6.1.Rosenblum.pdf

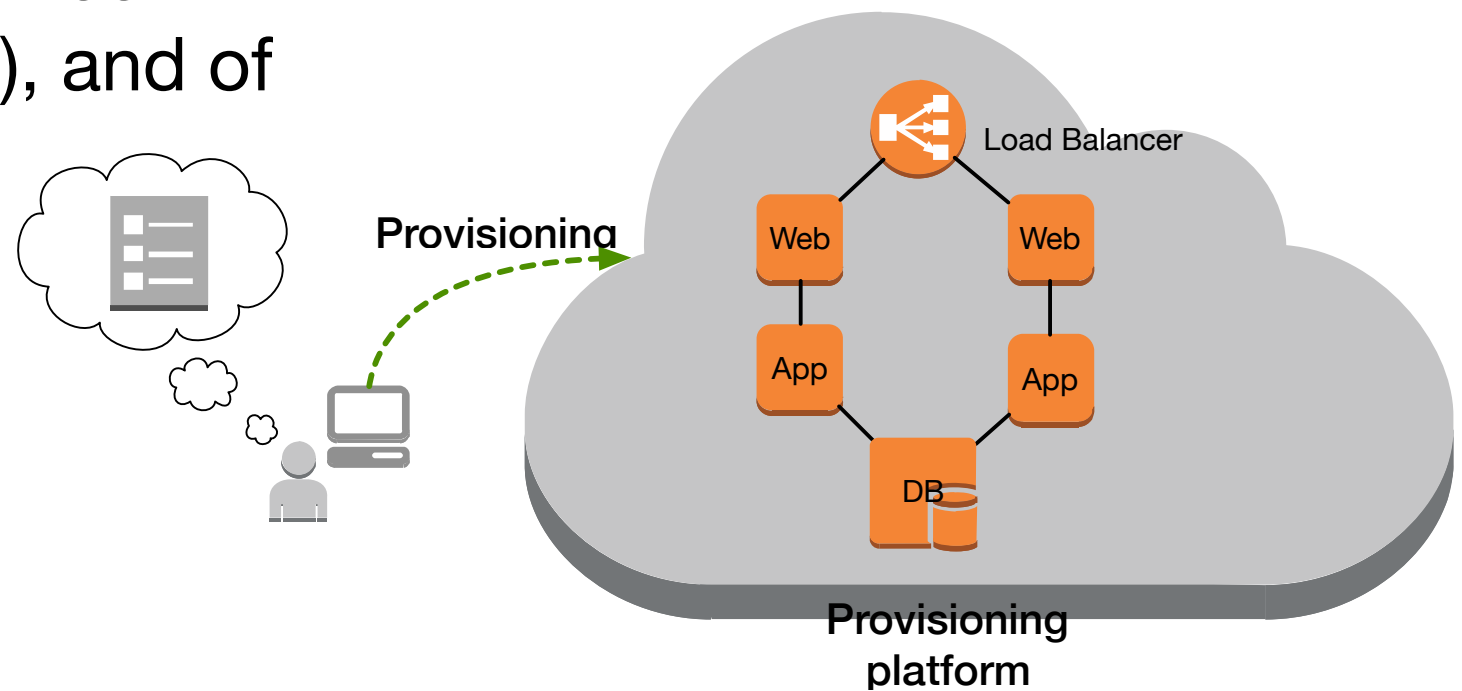


OS virtualization

- Provides multiple isolated OS environments which is called containers.
 - Same look & feel OS from customers.
 - Linux Containers (LXC), Linux-VServer, FreeBSD Jail.
 - Lower overhead than virtual machine (VM).
- Container isolates computing resources from the point of view of application. QoS support is behind VM because it relies on host OS.
 - CPU and memory : process
 - Storage : filesystem similar to “chroot”
 - Network : interface, socket

Cloud computing & virtualization

- PaaS / IaaS are comprised of platform which supports service deployment (or provisioning), and of its manager.
The platform is based on virtualization technologies.



Service Provisioning (or Deployment)

- Creates VMs/Containers and manage their lifecycle as:
 - Reserve system resources
 - Install OS / applications / Libraries
 - Start and watch VM
 - Stop VM and releases VM resources
- With OpenStack, CloudStack, or proprietaries.
- Works at server-hosting as well.
Intelligent Platform Management Interface (IPMI) is helpful.

Immutable infrastructure and disposable components

- Cost for frequent updates on applications and infrastructures
 - New features, bug-fix, security patch, downgrade.
- An instance lifecycle in Cloud
 - 1.Resource provisioning
 - 2.Application provisioning
 - 3.Service starts
 - 4.(Resource adding / deleting / migrating)
 - 5.Application stopping (,or crashing)
 - 6.Release resources
- To meet the above lifecycle, immutable infrastructure and disposable components design practice is useful.

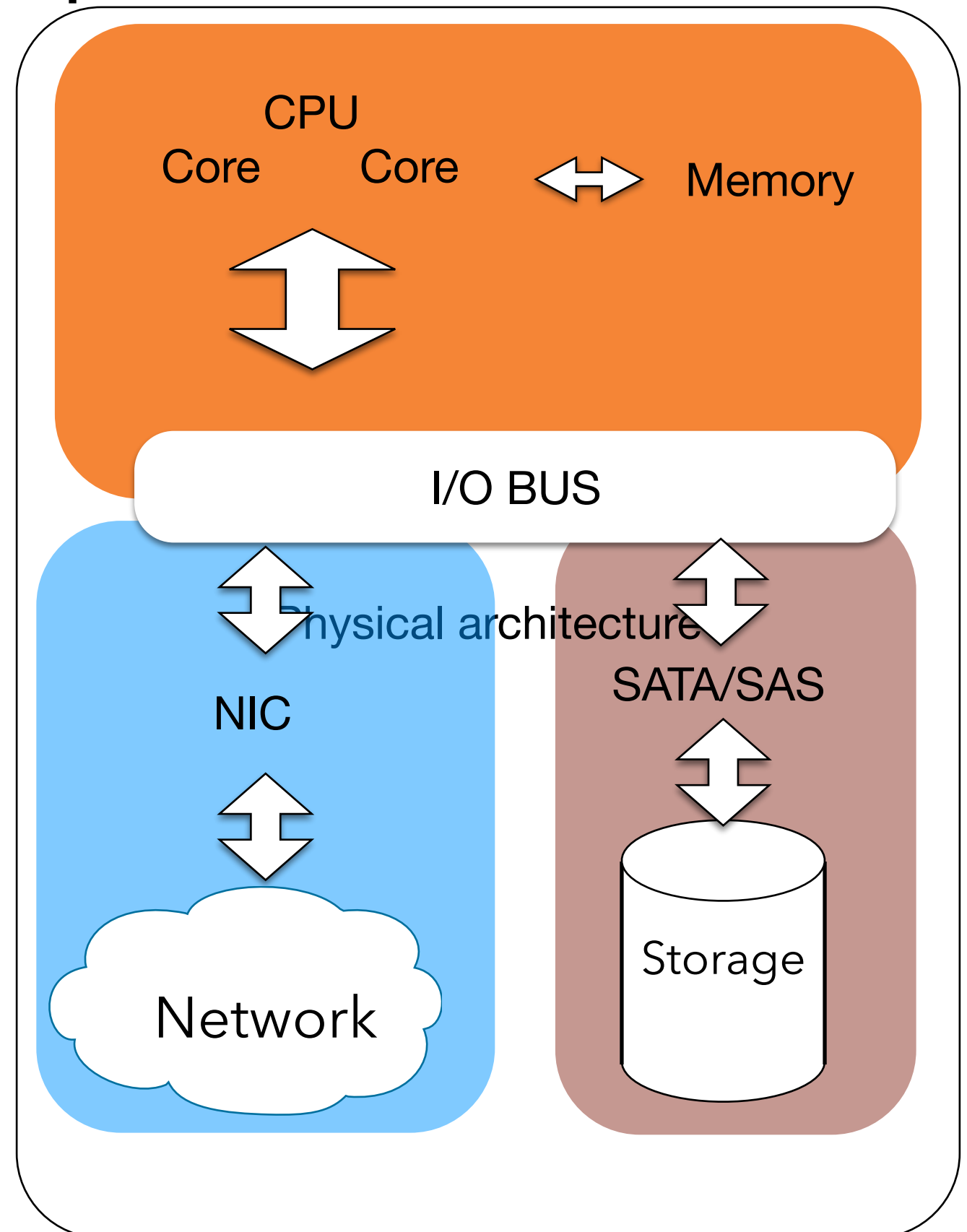
Chad Fowler, "Trash Your Servers and Burn Your Code: Immutable Infrastructure and Disposable Components",
<http://chadfowler.com/2013/06/23/immutable-deployments.html>

Virtualize various computer HW resources

- CPU / Core / Memory
- Hypervisor
- Container manager

- Network
- Virtual NIC + Virtual LAN

- Storage
- Disk image, RAID, Storage Area Network (SAN), Distributed File System



Outline

1. Administravia

2. Review polling

3. Cloud Computing (cont'd)

- Server Virtualization
- Virtualization with network / storage

Network and Storage virtualization

- Network virtualization:
 - 802.1q VLAN, Virtual NIC, Virtual Bridge, Link aggregation, Tunneling (VPN)
 - Proprietary techs.
- Storage virtualization:
 - Block storage
 - HDD image : Amazon EBS (Elastic Block Storage)
 - RAID, Storage Area Network (SAN)
 - Object storage
 - Amazon S3, GFS

Today's assignment

- With the Japanese government supports, RIKEN provides high-performance computing system as known as “K (京)” computer.
1. Is “K computer” is a cloud computing service in terms of NIST definition ?
 - If your student ID is odd : Tell reason why it is “cloud computing” service.
 - Otherwise (or ID is even) : Tell reason why it is NOT “cloud computing” service.
 2. If “K computer” is cloud computing service. Which service model is K-computer ? Which deployment model is K ? Tell reason why this service and deployment models fit to it.
- Submit your answers in Japanese or English via the course web.
 - NIST : <http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf>
 - K-computer :
 - System: <http://www.aics.riken.jp/en/k-computer/system>
 - Guide for applicants : http://www.hpci-office.jp/pages/e_k_guidance

本日の課題

- 理化学研究所は「京」コンピュータとしてしられる高性能コンピューティングサービスを提供している。
- 1. 「京」は NIST 定義によるクラウドコンピューティングに該当するか？
 - 学績番号が奇数：クラウドコンピューティングに該当する理由を述べよ。
 - それ以外（番号が偶数）：クラウドコンピューティングに該当しない理由を述べよ。
- 2. 「京」がクラウドコンピューティングとして、いずれのサービスモデルに該当するか？いずれの展開モデルに該当するか？サービスモデル、展開モデルに適合する理由を述べよ。
- 講義 web から日本語か英語で回答すること。
- NIST : <http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf>
- K-computer :
 - System: <http://www.aics.riken.jp/en/k-computer/system>
 - Guide for applicants : http://www.hpci-office.jp/pages/e_k_guidance

Next class

- Cloud Service components
- Scale-up and scale-out
- Datacenter

Cloud computing service components

- Additional components for efficient services
 - Load Balancer, Domain Name System(DNS), Datastore incl. both Relational Database (RDB) and NoSQL , E-mail,...
- Primitive PaaS / IaaS can provide the same services. However, such components are not optimal. These are because :
 - Customer does not have the knowledge of the underlying systems.
 - Customer cannot achieve high-level scalability without own efforts.
 - Unacceptable risk that customer manages critical services, such as, DNS.

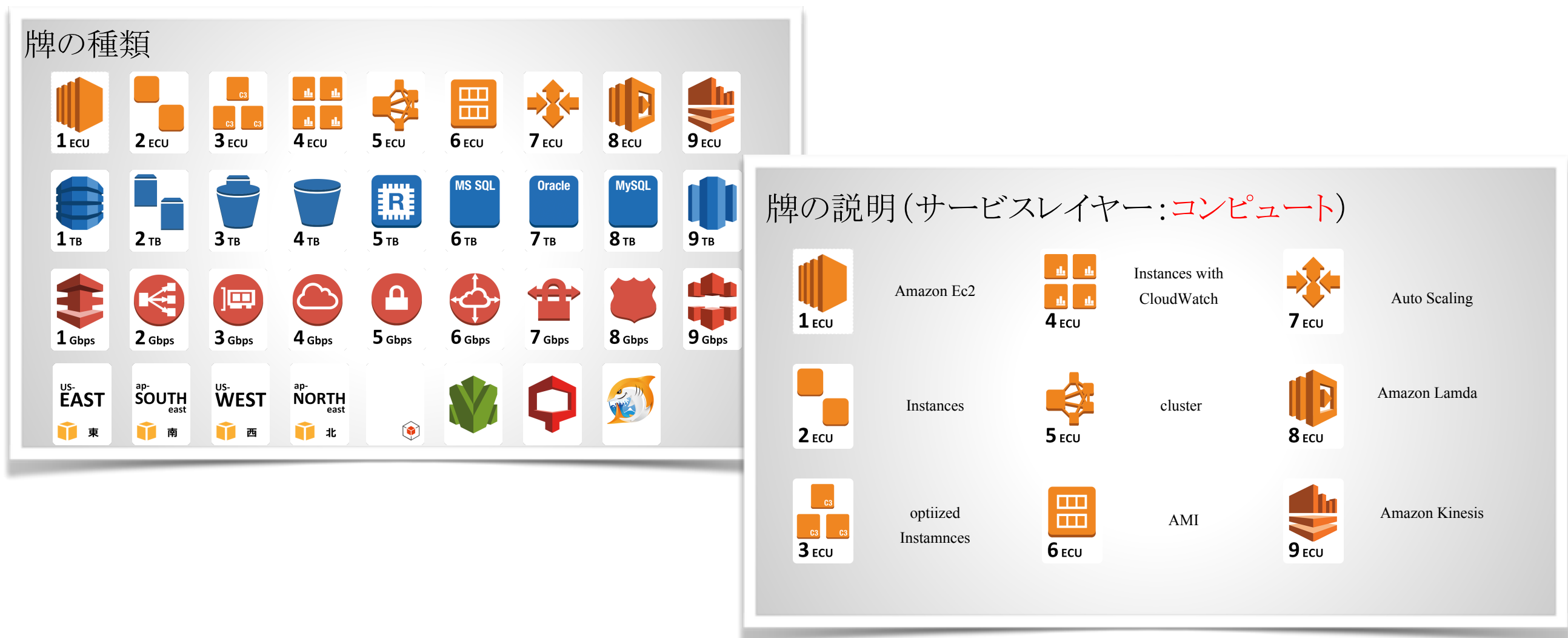
A lot of service components

- AWS customers build services with the combination of its components.
- My AWS console is overflowed with its service component icons...



AWS mahjong was invented

■ ■ ■



JAWS-UG, "AWS麻雀・ドンジャラ CDP役一覧 Ver1.0", 2015