UNIVERSITÀ DEGLI STUDI
DI MILANO

Gaming in the Cloud

Lesson I04

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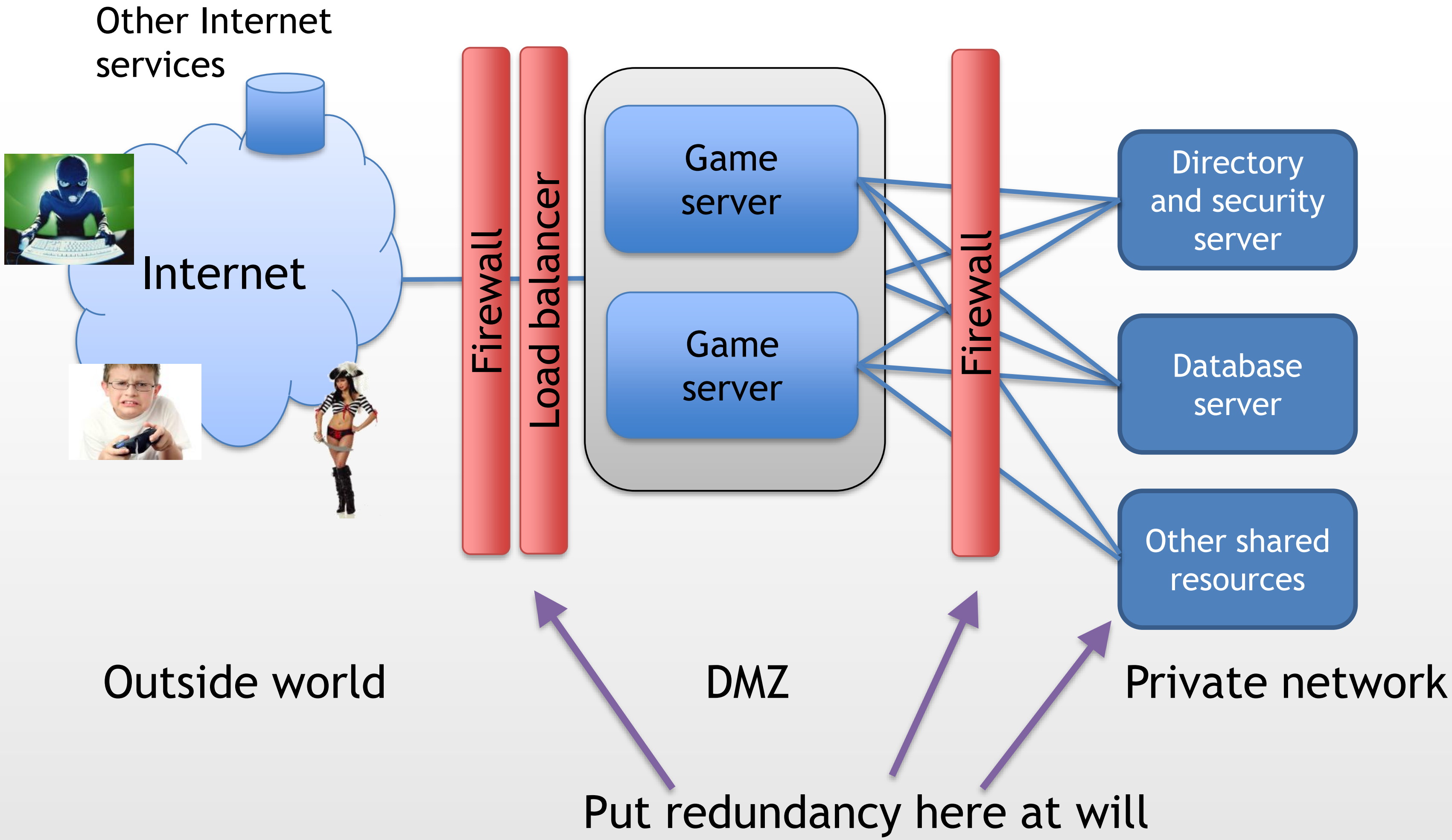
Online Game Design - A.A. 2021-2022

AH is Required Because Hardware Breaks!



How Big is It ?

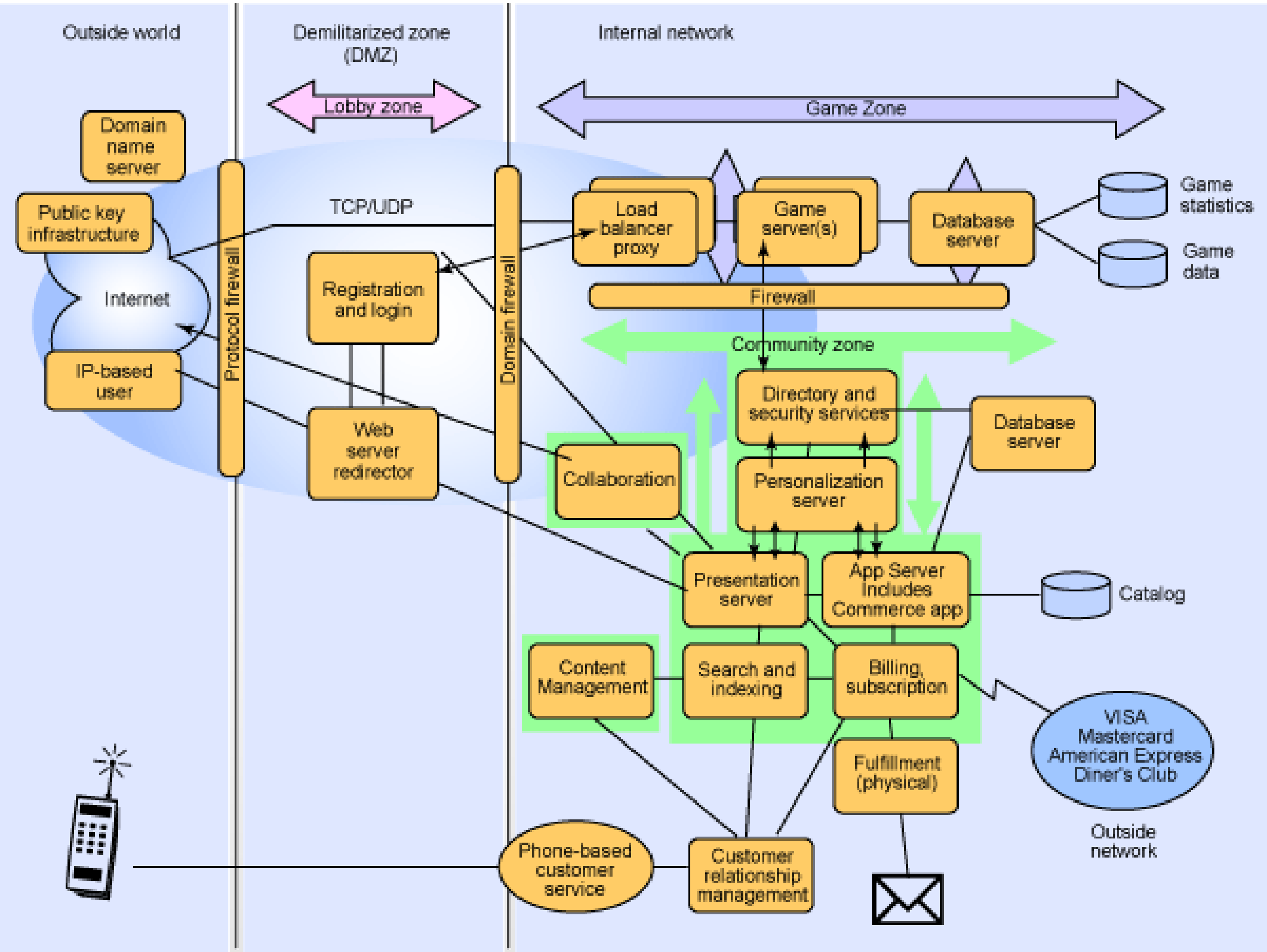
- Space matters!

- You may have one or more
  - Servers
  - Storage
  - Firewalls
  - Network boxes
  - Miles and miles of cabling

- Collapsing services in the same box is good for space but (very) bad for faults
  - A broken motherboard will kill more services

- Think about a good tradeoff
  - And think that your business may (hopefully) grow and you will need more resources

Network is Complex/Huge … and Things May Get Really Ugly!



… and the System May Get Distributed

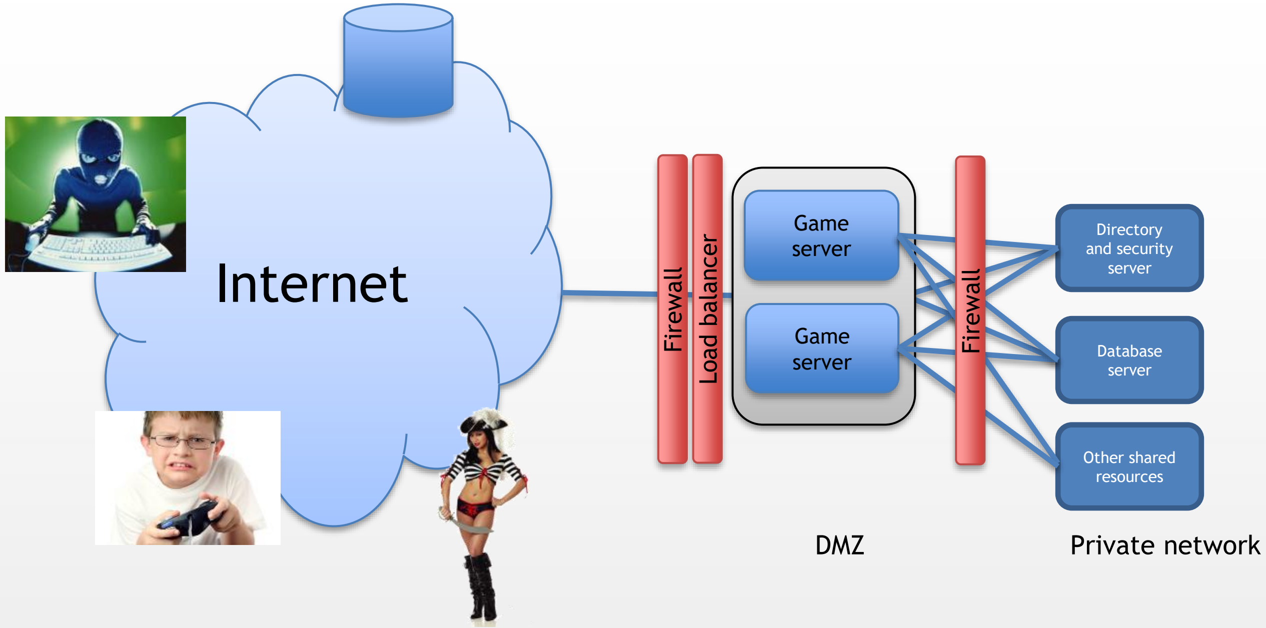
- For performance reasons, clustering might not be enough; we might need geographically distributed servers due to:
  - Latency
  - Cultural localization
  - Economical barriers
  - Censorship/taxes/local laws
  - Keeping everything in sync is <u>a big challenge</u>

- You might need your own Content Delivery Network (CDN)

Where do We Put Them ?

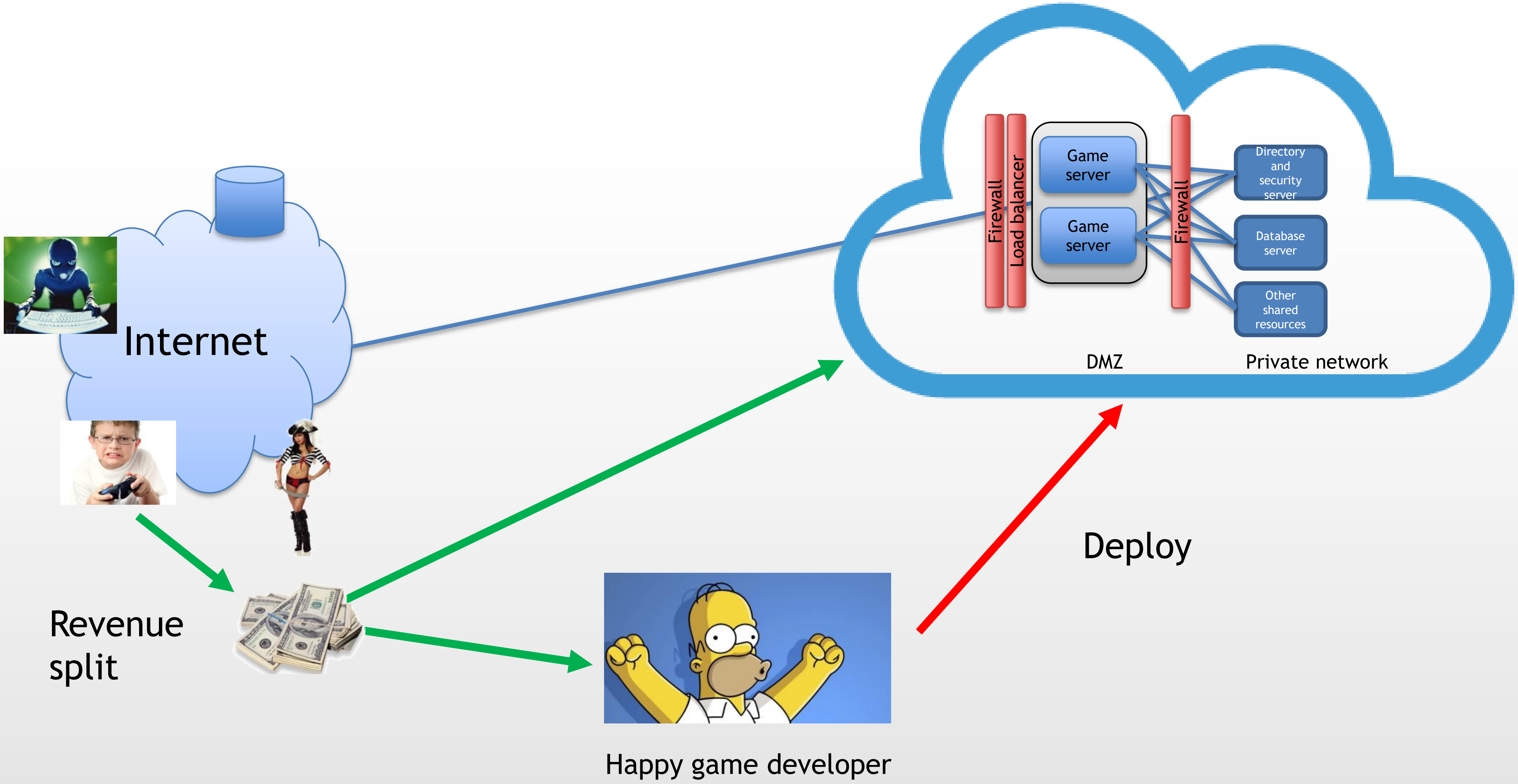
- Not everyone has a huge hangar where to stock hardware and cabling
- Housing
  - Rent the space for your machine
  - Someone will take care of housekeeping and power
- Hosting
  - Rent a machine for your service
  - Someone will take care of backup and connectivity
- Clouding
  - Put it somewhere on a virtual infrastructure
  - Someone will take care to send you a bill

Truth is … You Do NOT Want to Own the System



This is not the infrastructure you are looking for

So … You Do NOT Want to Own the System



Internet

Firewall

Load balancer

Game server

Game server

Firewall

Directory and security server

Database server

Other shared resources

DMZ

Private network

Deploy

Revenue split

Happy game developer

Why Using the Cloud

- While all concepts from the previous lesson still hold, there is a huge question still unanswered

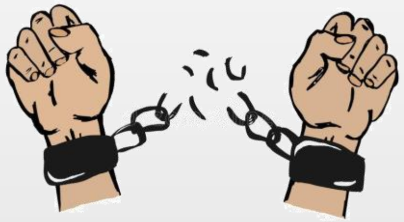
- Should I buy the server?
  - Because it is very expensive
  - Because it needs money (continuously) for maintenance
  - Because it is losing value very fast over the years
  - Because it is a scarcely reusable asset

- That was a (partial) motivation why not every game used to be online

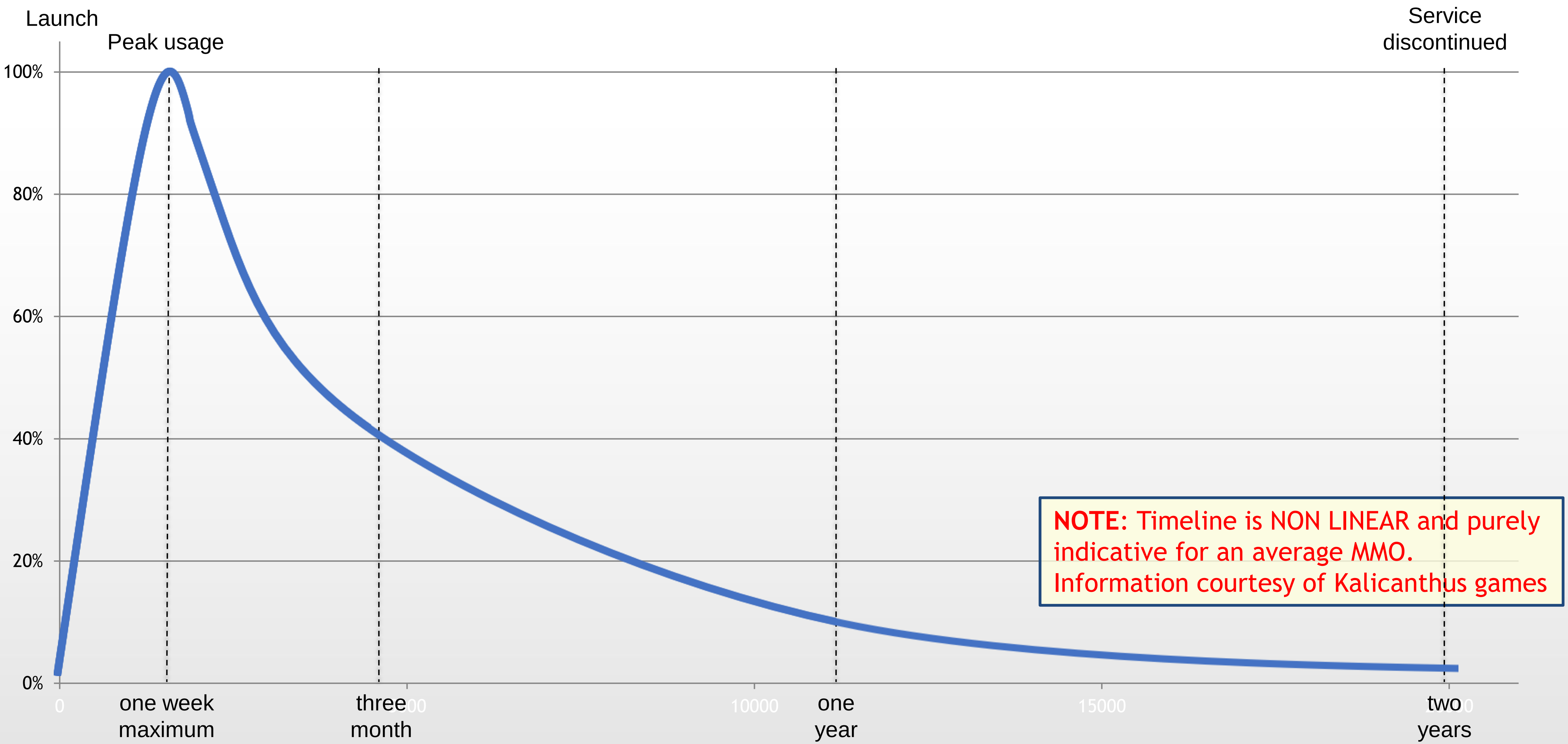
  Let’s try to explain why

Average User’s Behavior for Online Games

1. Buy the game
2. Run home (if needed)
3. Install
4. Play insanely for one week
5. Come back to real life
6. Play moderately until content is expended
7. Wait for the next update or change game
8. Go back to point 1



System (Over)Load Evolution



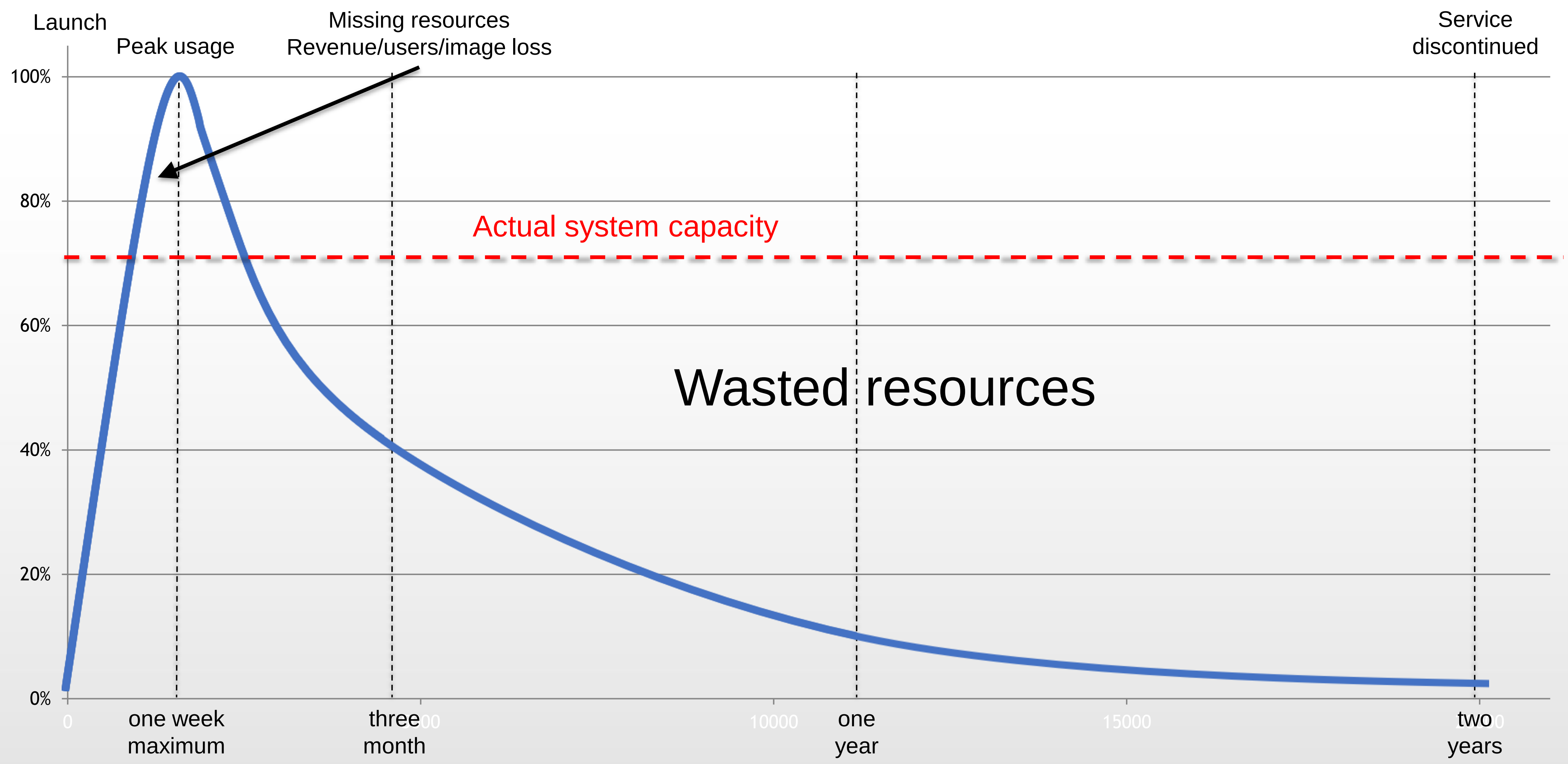
NOTE: Timeline is NON LINEAR and purely indicative for an average MMO.
Information courtesy of Kalicanthus games

Classical Approach (On-Site System)

- If we adopt a classic (maybe vintage) approach, we want to:
  - Buy a computer to run as a server
  - Put into account expenses to deploy and manage it
    - Including backups, upgrades and hardware refresh
  - Hire dedicated personnel to ensure the service stays up 24/7

- Problems:
  - It was very expensive
  - You have to get the “right” formula without any sort of hint

System (Over)Load Evolution

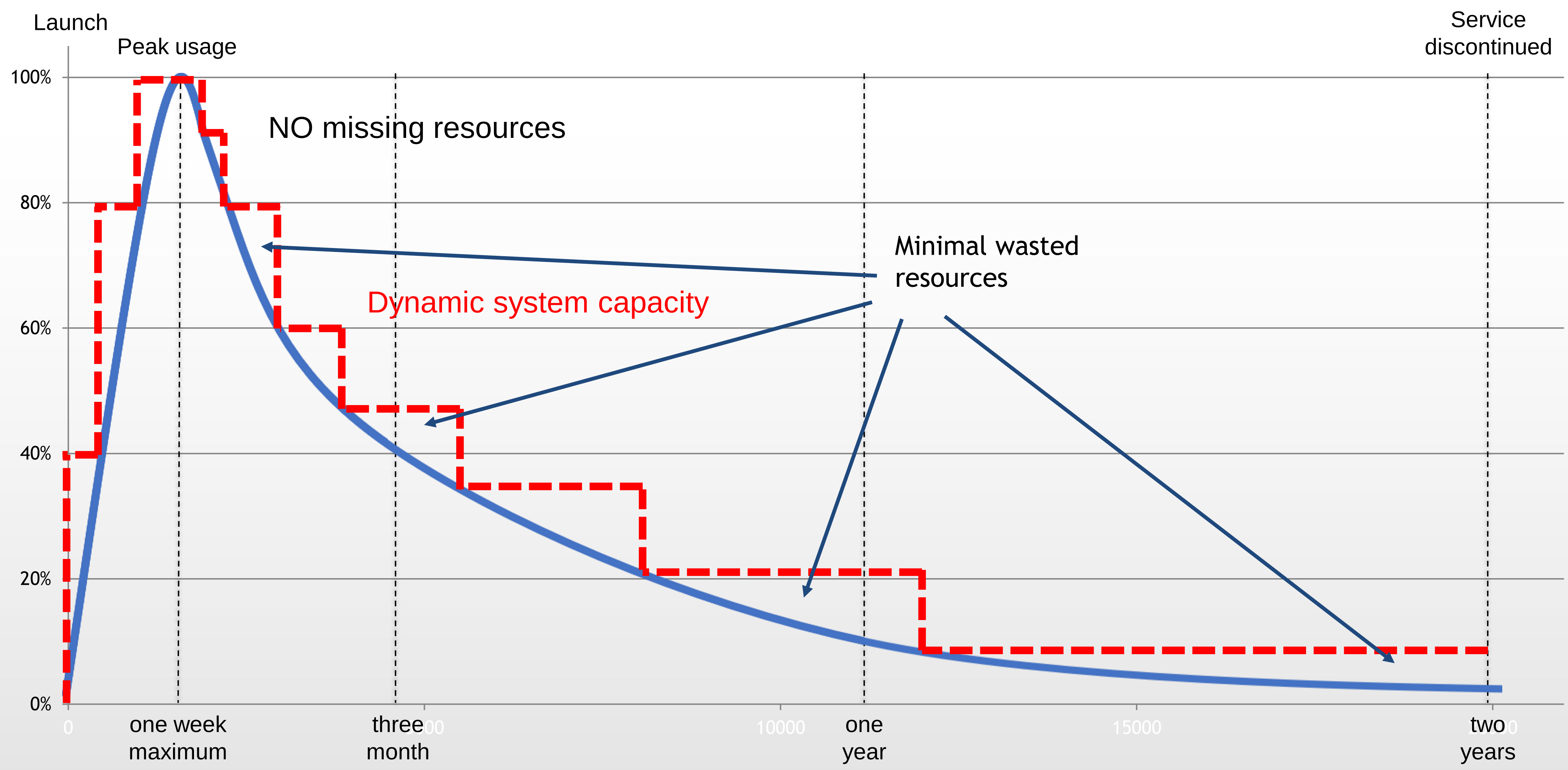


The *Cloud Approach*

- The computer is required but I do not care about having it in my datacenter (I do not have a datacenter)
  - Moreover, I need one configured on purpose … and I want to enlarge and shrink it when needed
- Do we really need to own a computing system?
  - Its purpose is "just" to run a software
  - Can I just have the software?
- I hate to waste resources
  - Better again, I want to pay only for the resources I am actually using

This is the same thing we do with water, power, and gas (!)

System (Over)Load Evolution



Now ... What is this ”Cloud” Stuff?

- Well, there is no “cloud for gaming” in the strict sense

- Games do not have their own cloud: they use a global cloud infrastructure, but they have (a few) specialized services
  - Cloud is “just” about virtualizing stuff to delegate high availability and business continuity

- So, what we must do first is to get acquainted with the ”usual” cloud architecture

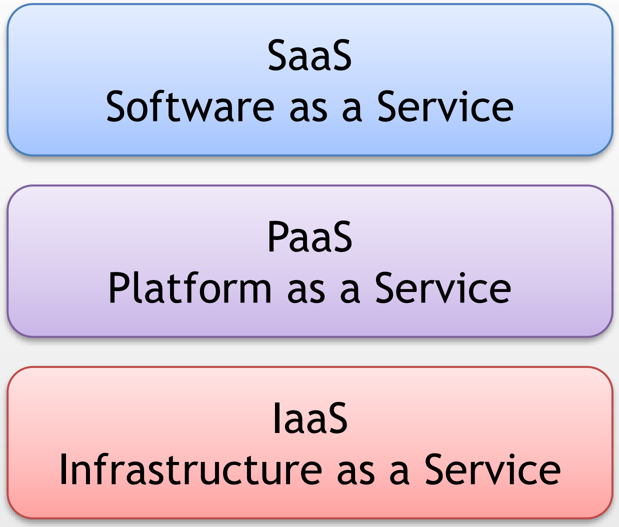
Definition of Cloud Computing from NIST

(National Institute of Standards and Technology)

Cloud computing is a model for enabling 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

“As A Service”

- As a matter of fact, we externalize processing and storage resources and we tap to them as services through the network
- The three-layered SPI architecture is the default approach up to date



SaaS
Software as a Service

PaaS
Platform as a Service

IaaS
Infrastructure as a Service

SPI Architecture

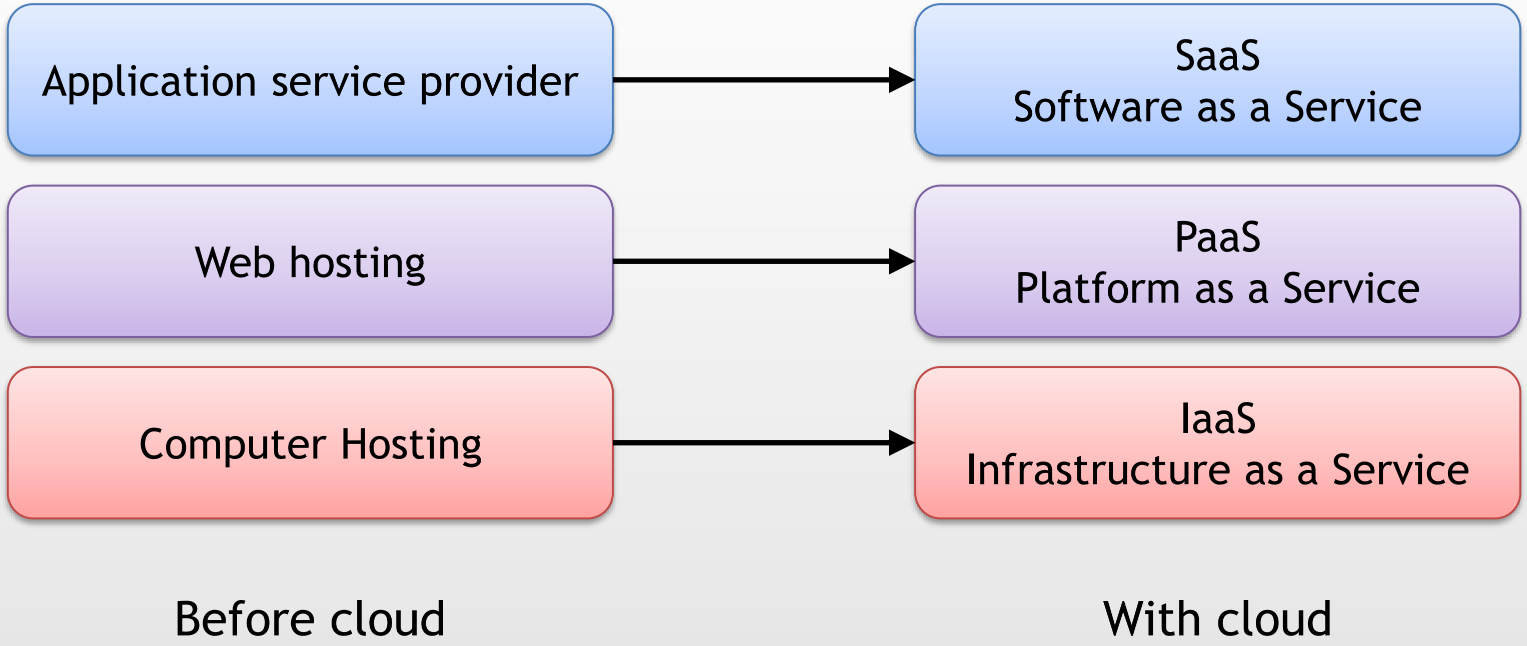
Distributed applications provided as a service

Virtualized environment/operating system provided as a service

Virtualized hardware provided as a service

Before and After

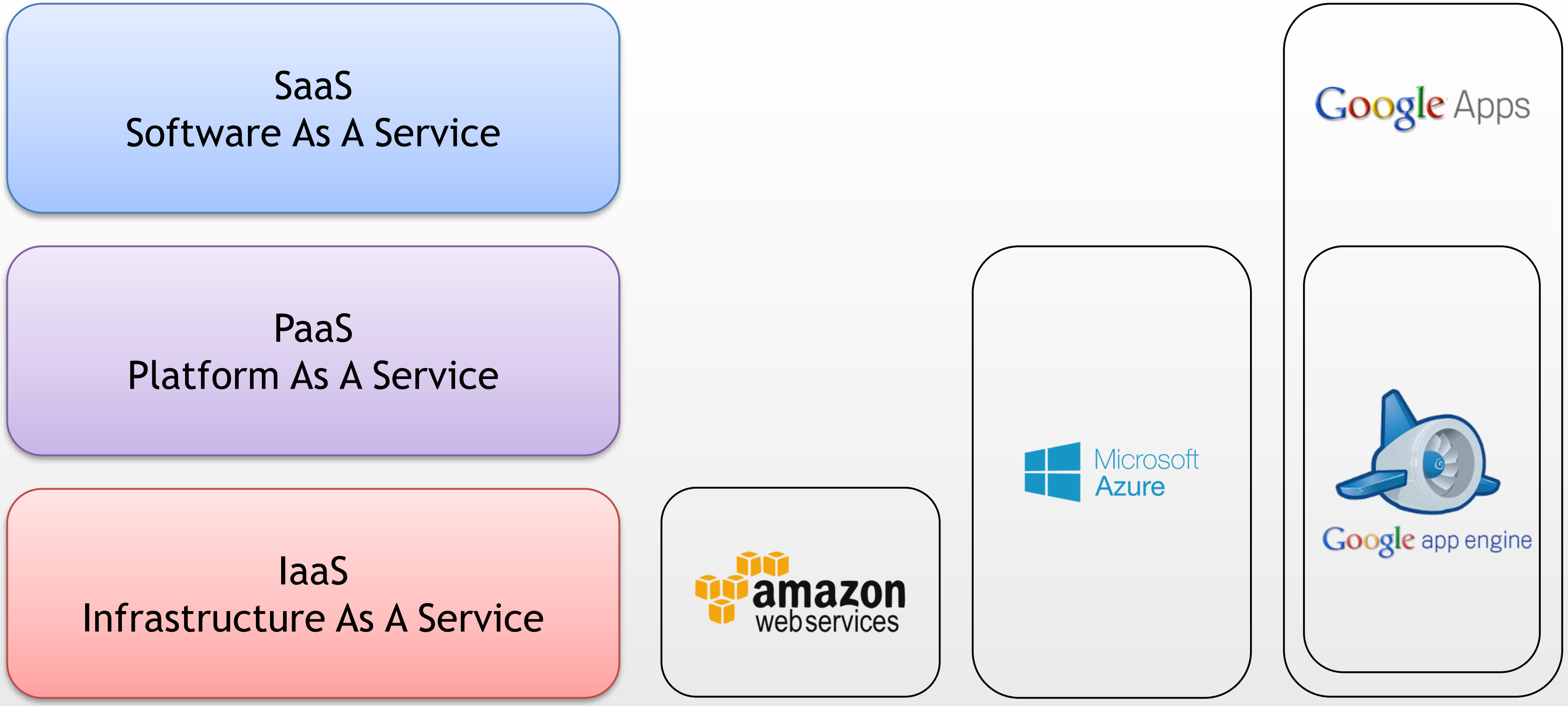
The SPI architecture is a more structured and service-oriented approach for solutions we already have been using for at least two decades in ICT



SPI Architectures on the Market

Target	Product	Provider	Platform
End User	SaaS Software as a Service	G	Google Cloud Platform
Developer	PaaS Platform as a Service	🟥🟩 🟦🟨	Microsoft Azure
System Engineer	IaaS Infrastructure as a Service	a	amazon web services

Even if in Reality …



SaaS
Software As A Service

PaaS
Platform As A Service

IaaS
Infrastructure As A Service

… and there are many other providers out there

Utility Computing

- The cloud is regarded as “Utility computing”
  - Services are monitored and managed by my provider
  - If I use a service, the provider will send me a bill with a pay-per-use policy

- The cloud should be
  - Efficient in using resources
  - Scalable
    - Adapt easily to different workloads
  - Elastic
    - Can be extended and reduced when needed
  - Without maintenance (for me!)
  - Always available
    - At least … a very large share of the times
  - Interoperable and portable
    - I should be able to mix different clouds and move my data between them

Four Kinds of Cloud

Must take this into account when I want one of them!

- Public
  - Accessible via the Internet, can be pay-per-use or free
    - Google, Microsoft, Amazon, and Facebook are here
- Community
  - It is shared between many subjects requiring homogeneous infrastructures
    - Like the cloud project for the Italian Public Administration
- Private
  - Inside a company, providing only internal services
    - When you have your own cloud
- Hybrid
  - A mix of the previous variants
    - When you are a truly masochistic engineer

Amazon Cloud (AWS) Game Services

https://aws.amazon.com/gametech/

- Lambda
  - Computing response to events
- Cloudfront
  - Content Delivery Network
- Kinesis
  - Data streaming in real time
- Cognito
  - Authentication and mobile data services
- GameLift
  - Adaptation to workload for multiplayer games

- S3
  - Durable storage
- Redshift
  - Petabyte data warehouse
- Glacier
  - Long term storage for archiving
- Elastic Cloud Compute
  - Cloud hosting for servers
- Aurora
  - Relational Database
- Dynamo DB
  - NoSQL Database

All the rest is just standard ICT stuff

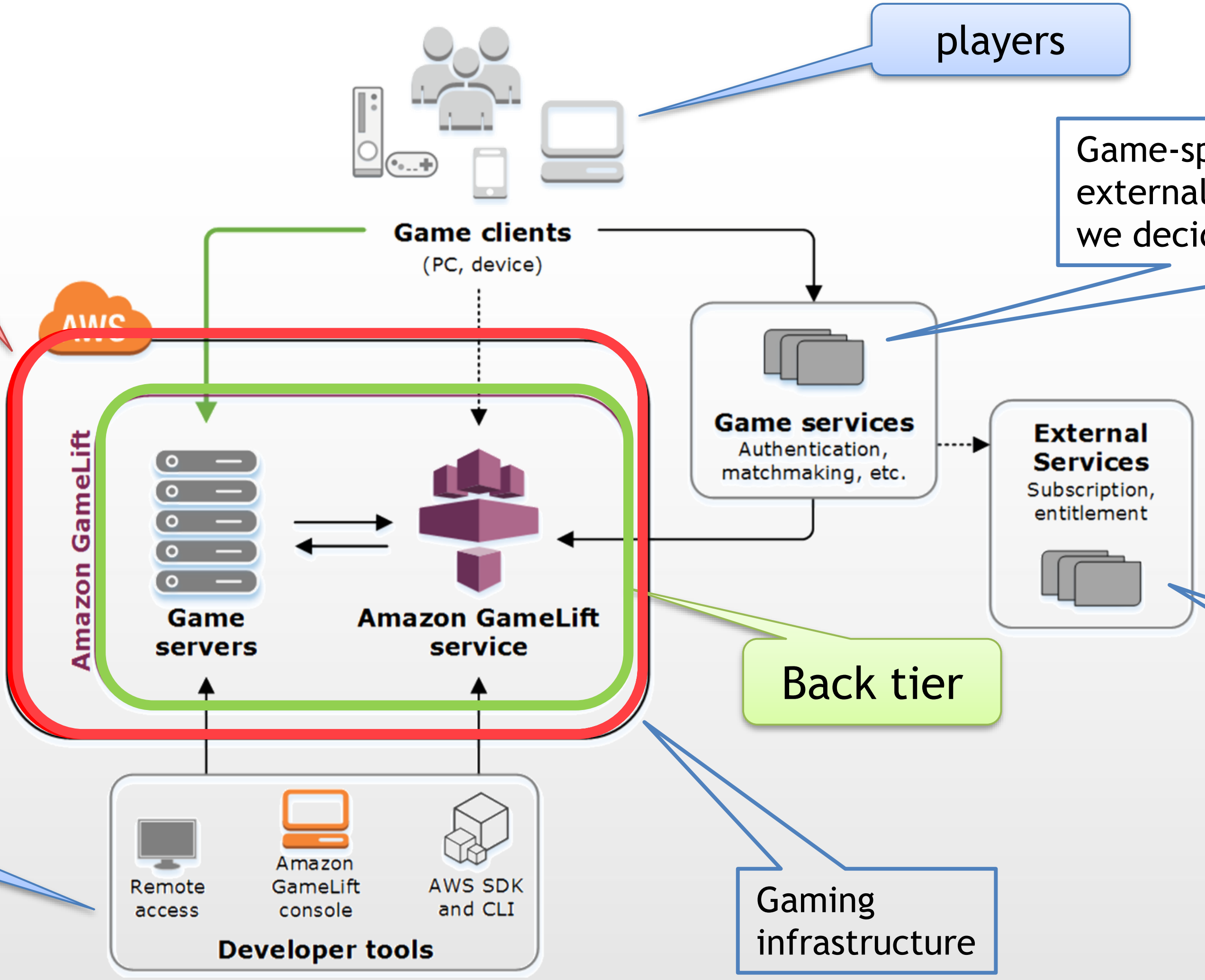
Yes! Just that!

Because a game is custom software deployed on a number crunching machine with a web server and a database attached.

If we are going to implement the game server all we need to add (really!) is a scalability policy understanding the semantic of games. Thus, Gamelift is more than enough for our needs

AWS GameLift

https://docs.aws.amazon.com/gamelift/latest/developerguide/gamelift-howitworks.html



players

Front tier

Back tier

Developer

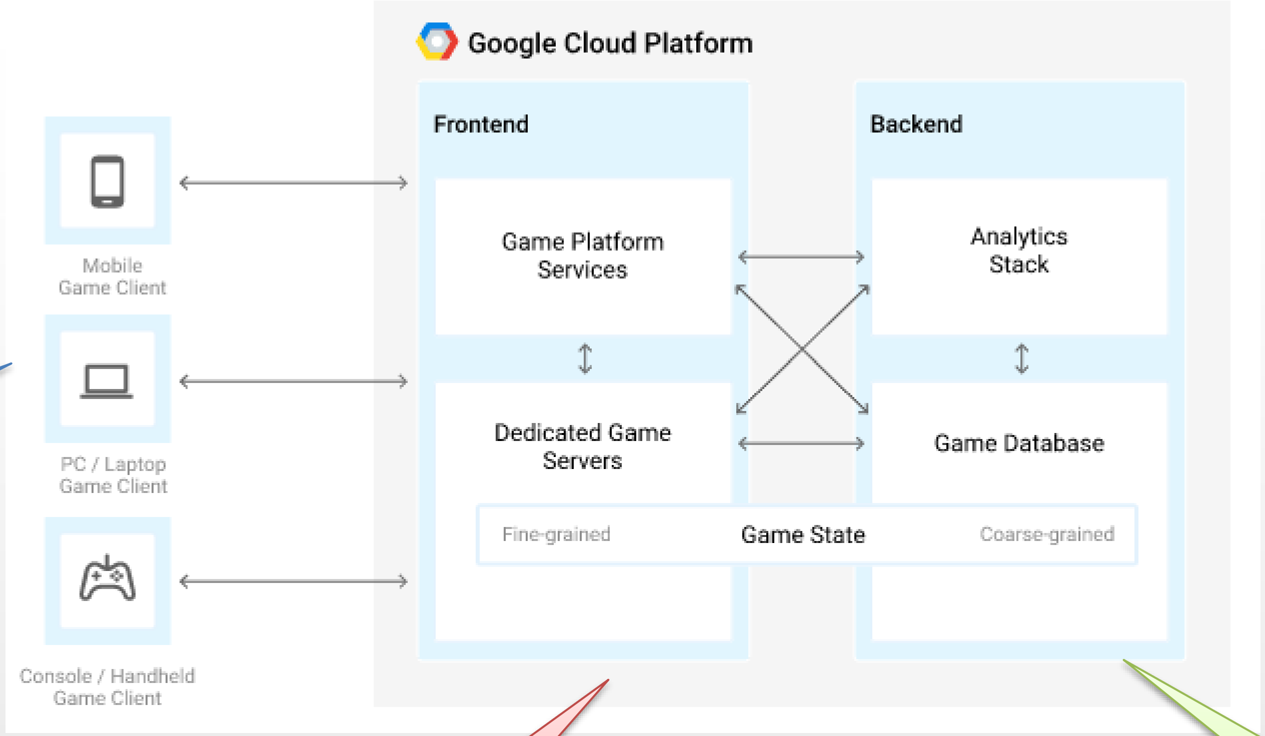
Gaming infrastructure

Game-specific services are provided externally. These are all services that we decided to keep out of the cloud

Game-specific services can also leverage on other third-party (not from Amazon) services. These could also be located in another cloud (but they are not telling us in the documentation)

Google Cloud Game Infrastructure

https://cloud.google.com/solutions/gaming/cloud-game-infrastructure



Developers and player

Front tier

Back tier

The Dark Side of the Cloud

- No book will write these down, but ask any system/network/DBA manager and see what is coming out for you
  - Anyway, some problems here below are typical of the Italian ecosystem

1. “You are holding it wrong” (cit.)
   - Many white collars looks to it just as a ”cut all expenses” scissor rather than a way to re-engineer the datacenter

2. Banks like it (in an unpleasant way)
   - Ever heard about CAPEX and OPEX?
     - Owning a computer is CAPEX, paying a monthly service is OPEX
   - A bank can get your computer, but it will be worth nearly nothing for them. On the contrary, forcing you to stop paying a fee will generate some cash to seize

The Darsk Side of the Cloud

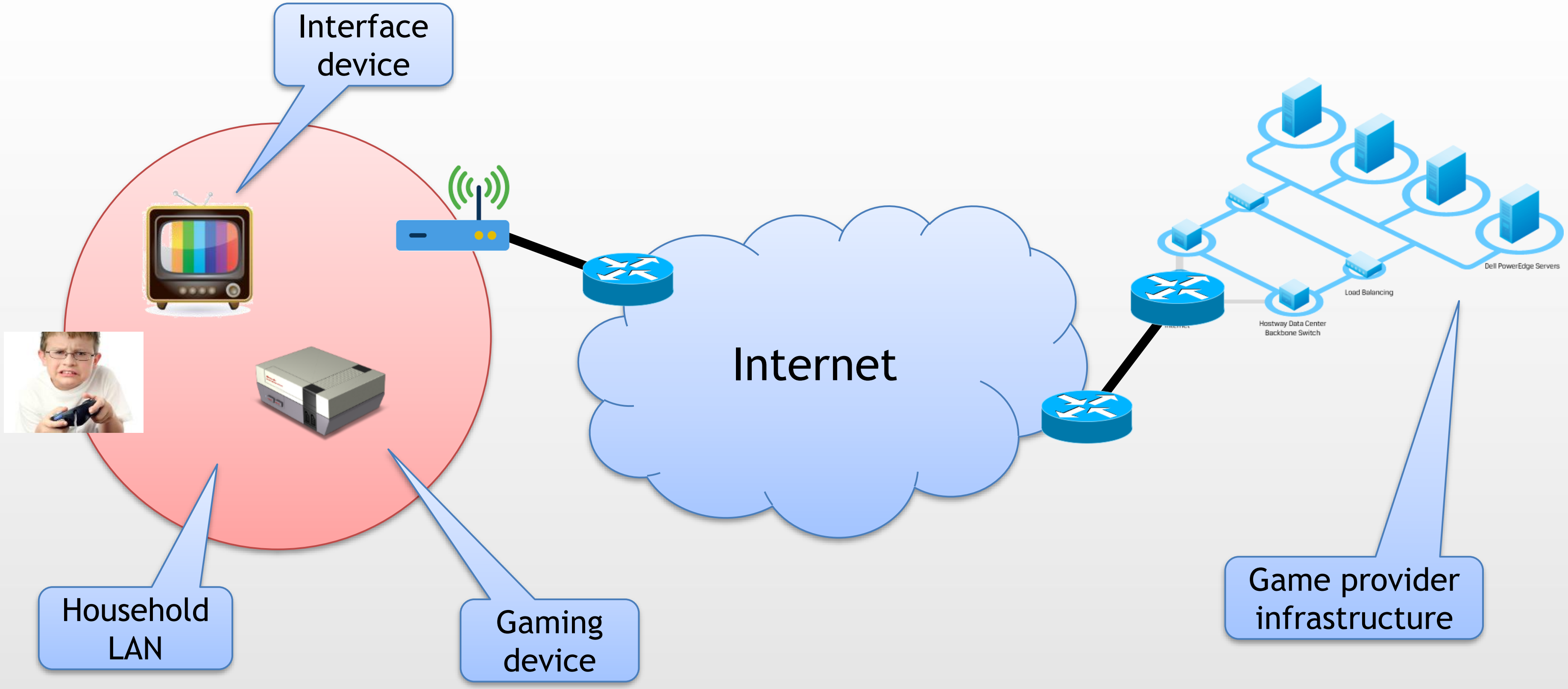
3. Is it really cheaper?
   - Still unknown
   - All providers are giving you estimate in revenue saving for no more than three year
     ... and then what?

4. Is the network a factor?
   - Definitely!
     - How much data are you moving?
     - How fast are you needing it?

5. Any standard out there?
   - Access APIs are standard (web 2.0) but HOW I must use them (layer 7 protocol) is strictly provider-dependent (giving you a lock-in)

Where is the Cloud?

Cloud is all about virtualizing stuff to delegate high availability and business continuity



Interface device

Household LAN

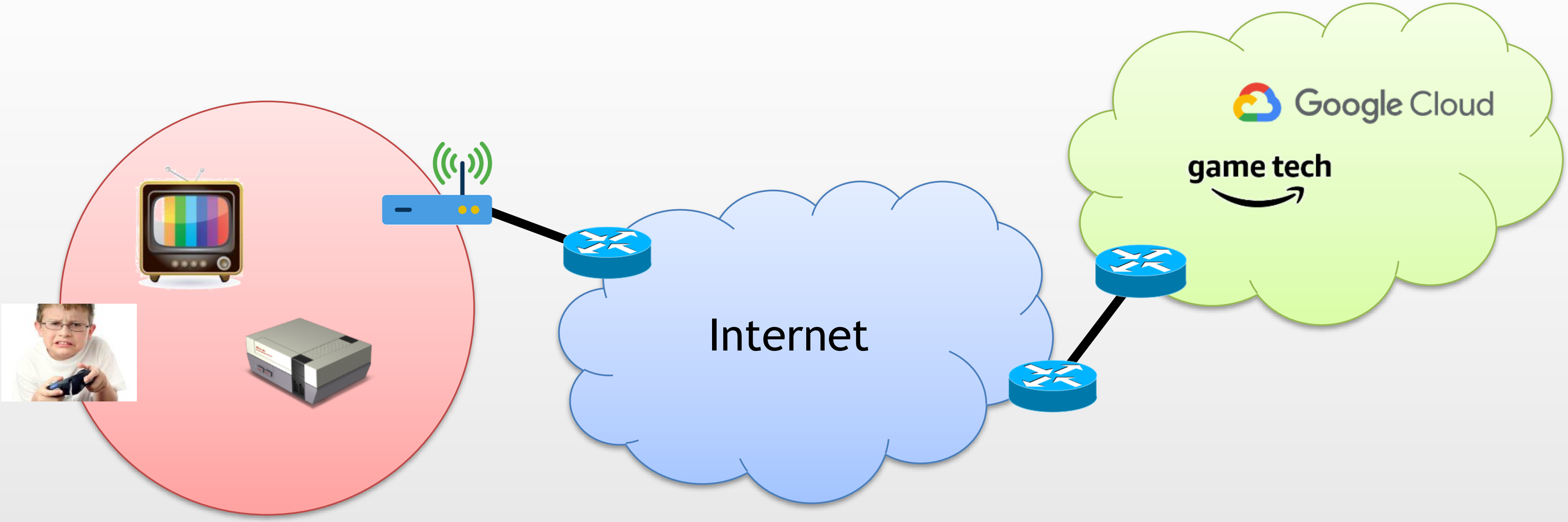
Gaming device

Internet

Game provider infrastructure

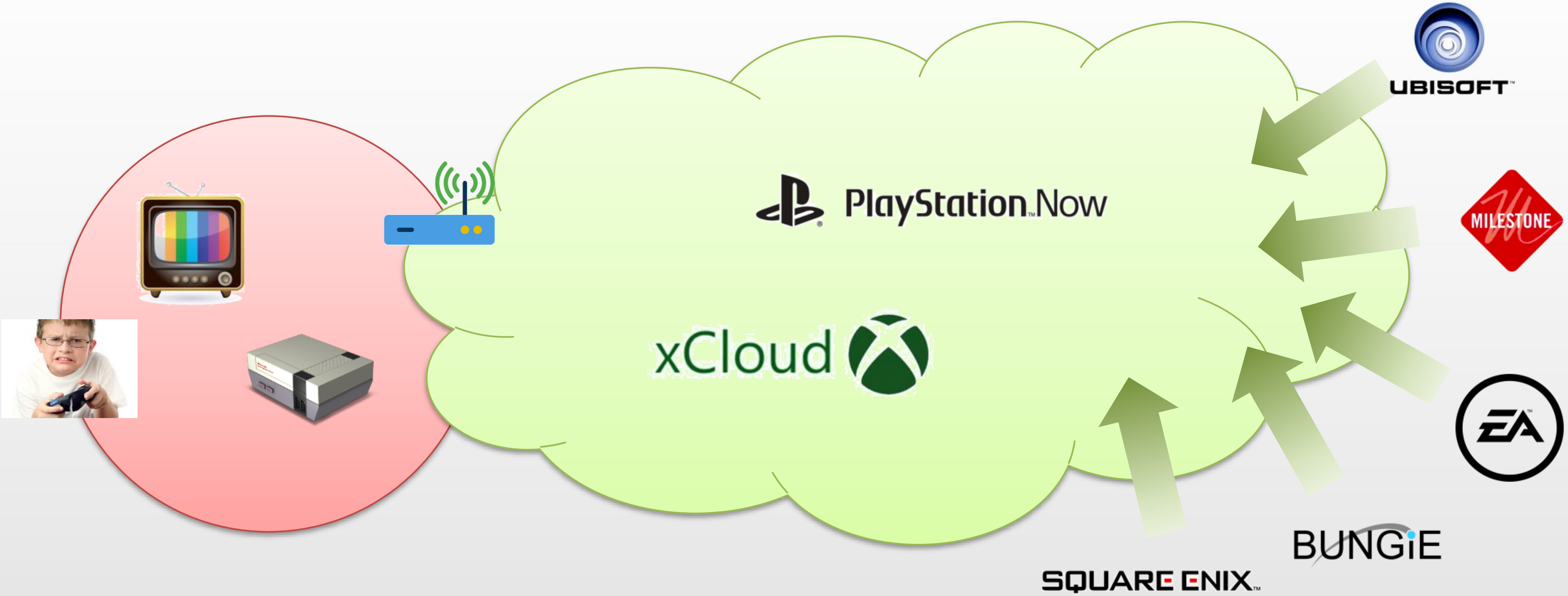
Where is the Cloud?

- First step: the game provider virtualizes its own infrastructure
  - Goals: reduce costs, increase scalability, and quickly reuse resource between different games



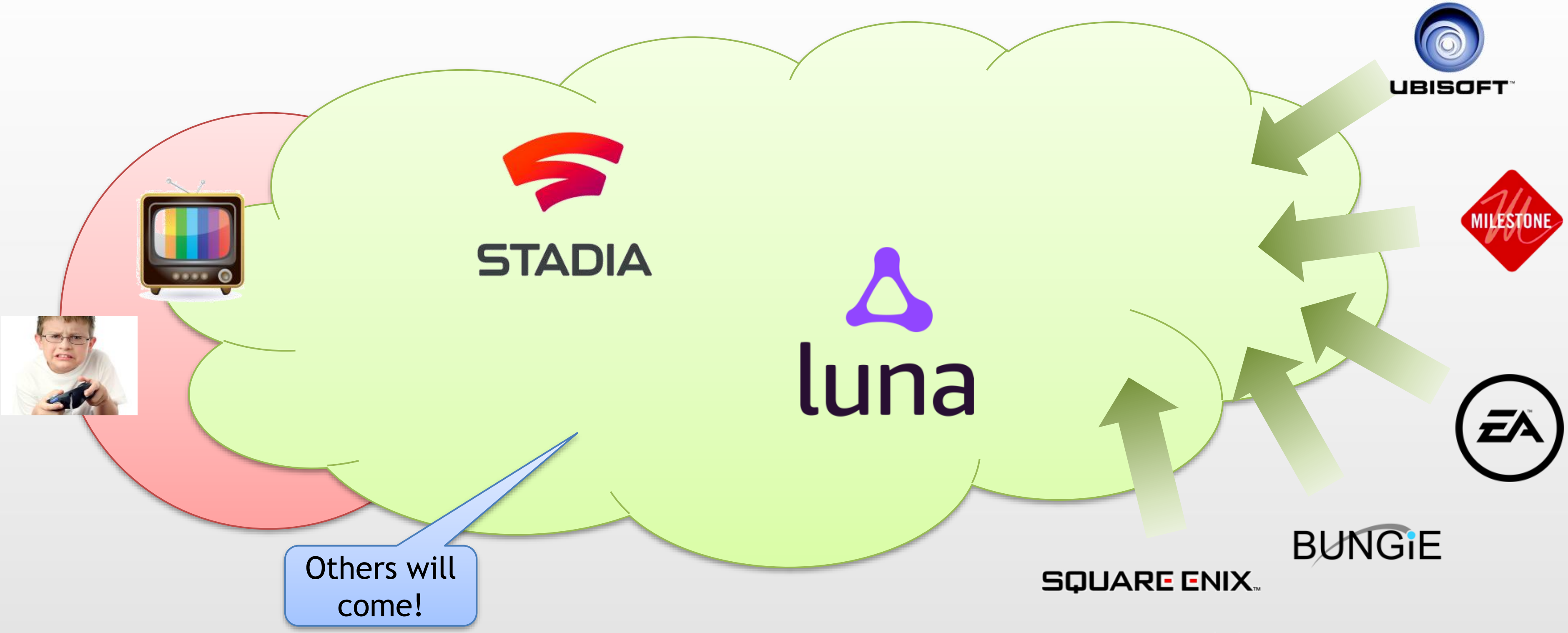
Where is the Cloud?

- Second step: a meta-provider creates a large virtualized infrastructure where game providers can deploy games
  - Goals: game providers do not need to care about infrastructure: infrastructure provider can share and reuse resources between different game providers

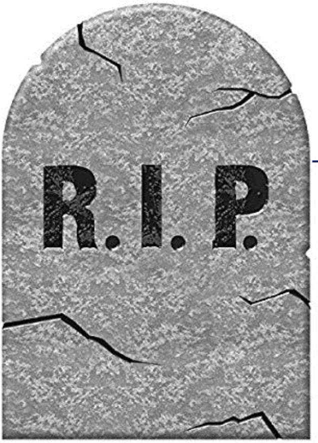


Where the .... is this Cloud?

- Third step: a provider is virtualizing EVERYTHING, even the console!
  - User receives just data



Other Gaming Clouds Have Already Been There!



VORTEX

utomik

Gamecloud

Blacknut

PIXELSTELLAR ALPHA

WIZTIVI

PLAYKEY.NET

NVIDIA GEFORCE NOW THE NEW WAY TO GAME

HATCH

SHADOW

Loudplay

WADE

mixedtek unify technologies

PLAYCLOUD

PROJECT ATLAS

LIQUIDSKY

TURBO.NET

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  § "How GameLift Works", § "How Realtime Servers Work"