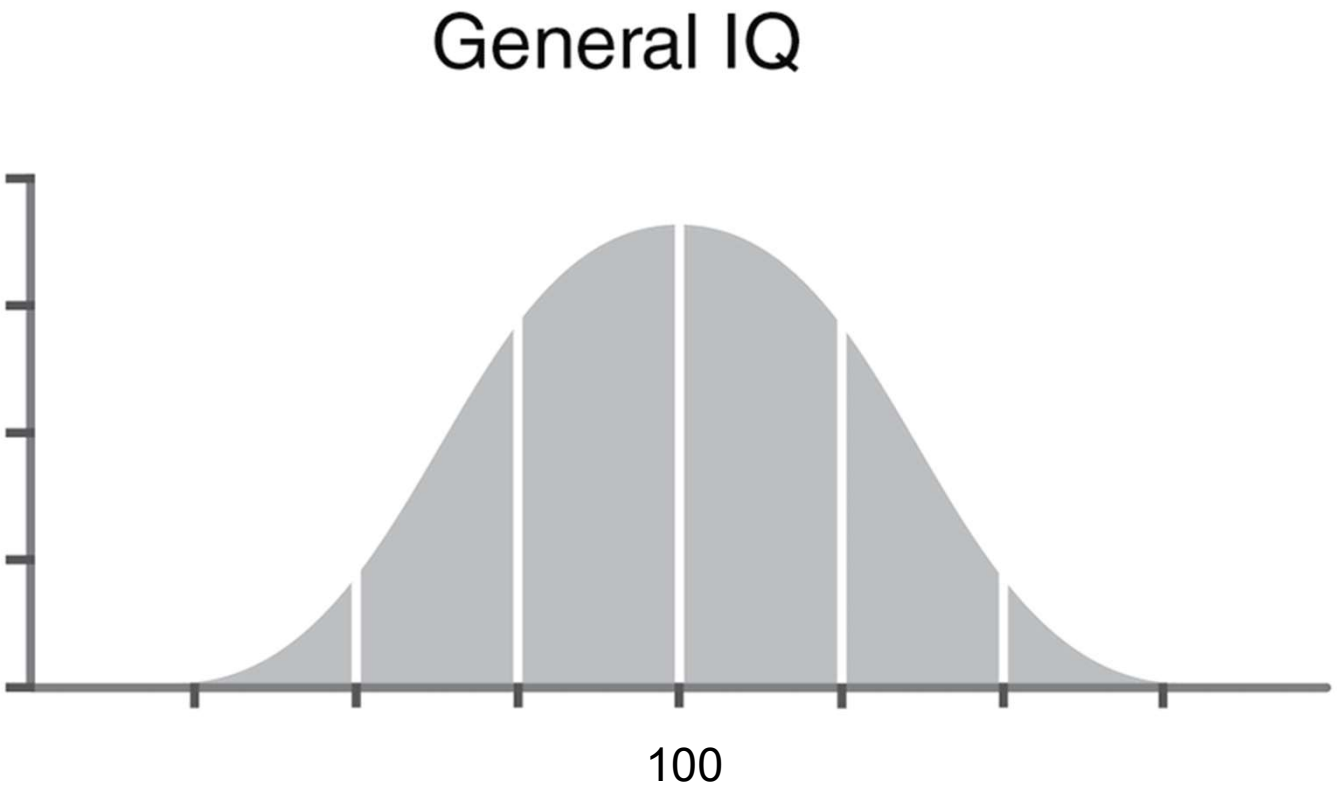
COMPUTER PRINCIPLES FOR PROGRAMMERS

Clients, Servers, and Clouds as a Service (thank you networks)

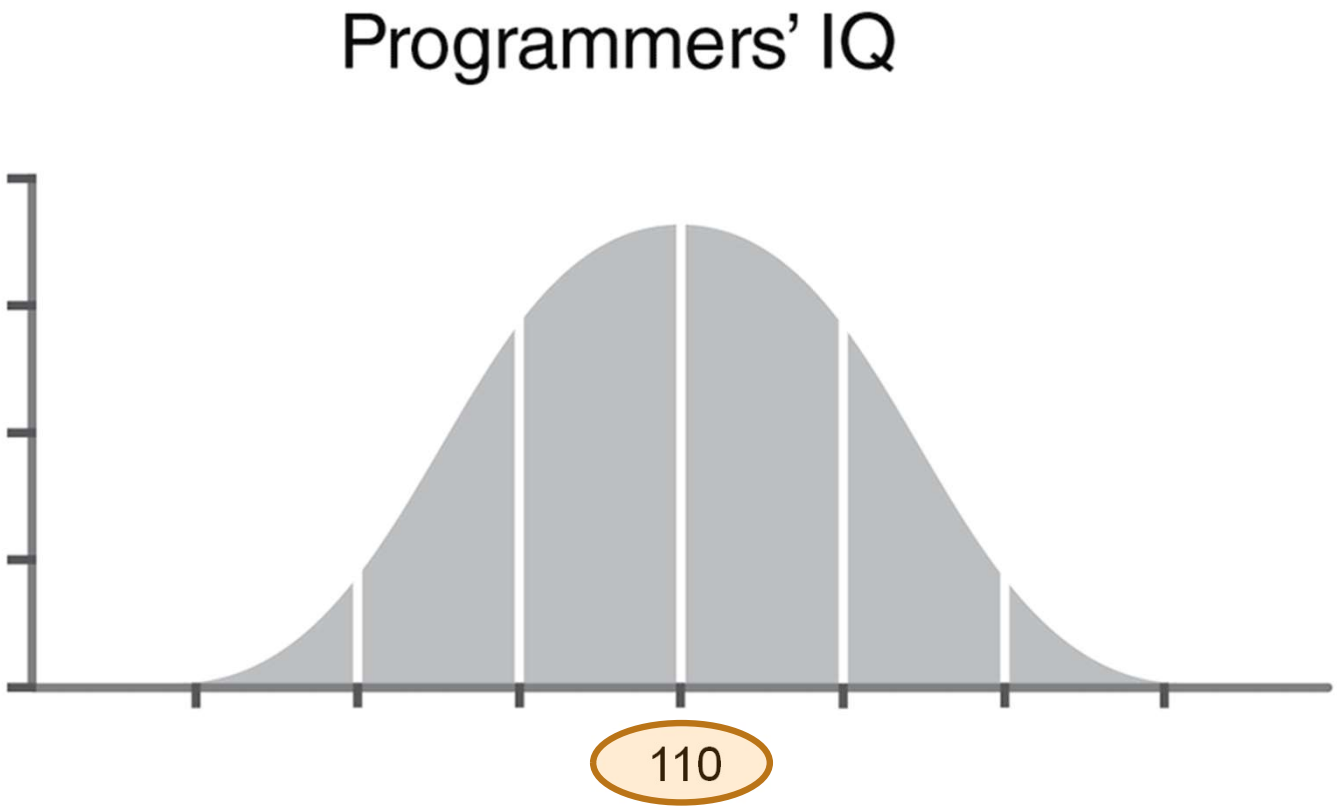
News of the Week

ICT has a great many languages and countless ways to do things.



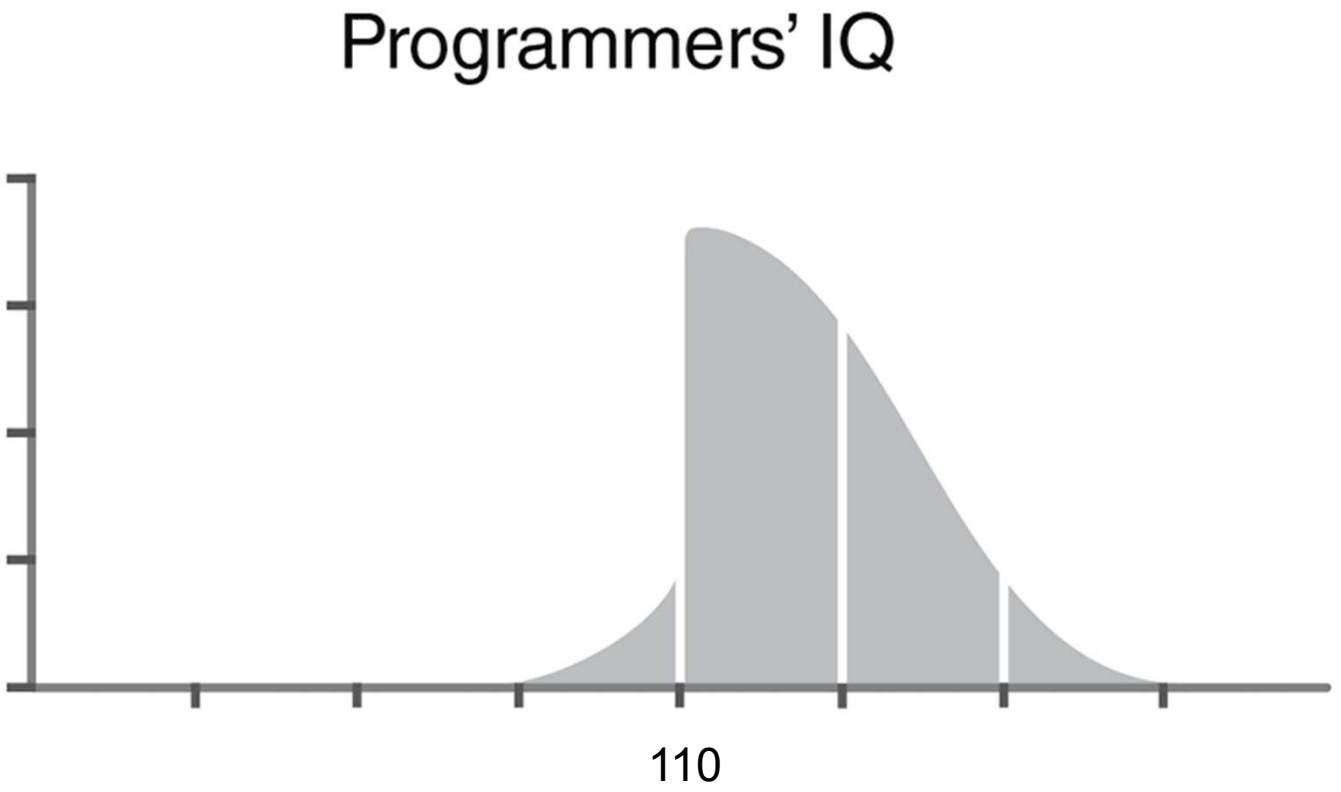
ICT has a great many languages and countless ways to do things.

This is partly why.



Why does ICT have many languages and countless ways to do things?

This is the other part.



Most programmers rate themselves above average.

Agenda

- Lecture:
  - Networks
  - Clients, Servers, and Services
  - Cloud Computing
    - networking and distributed computing
    - types of Cloud Computing: IaaS, PaaS, and SaaS.

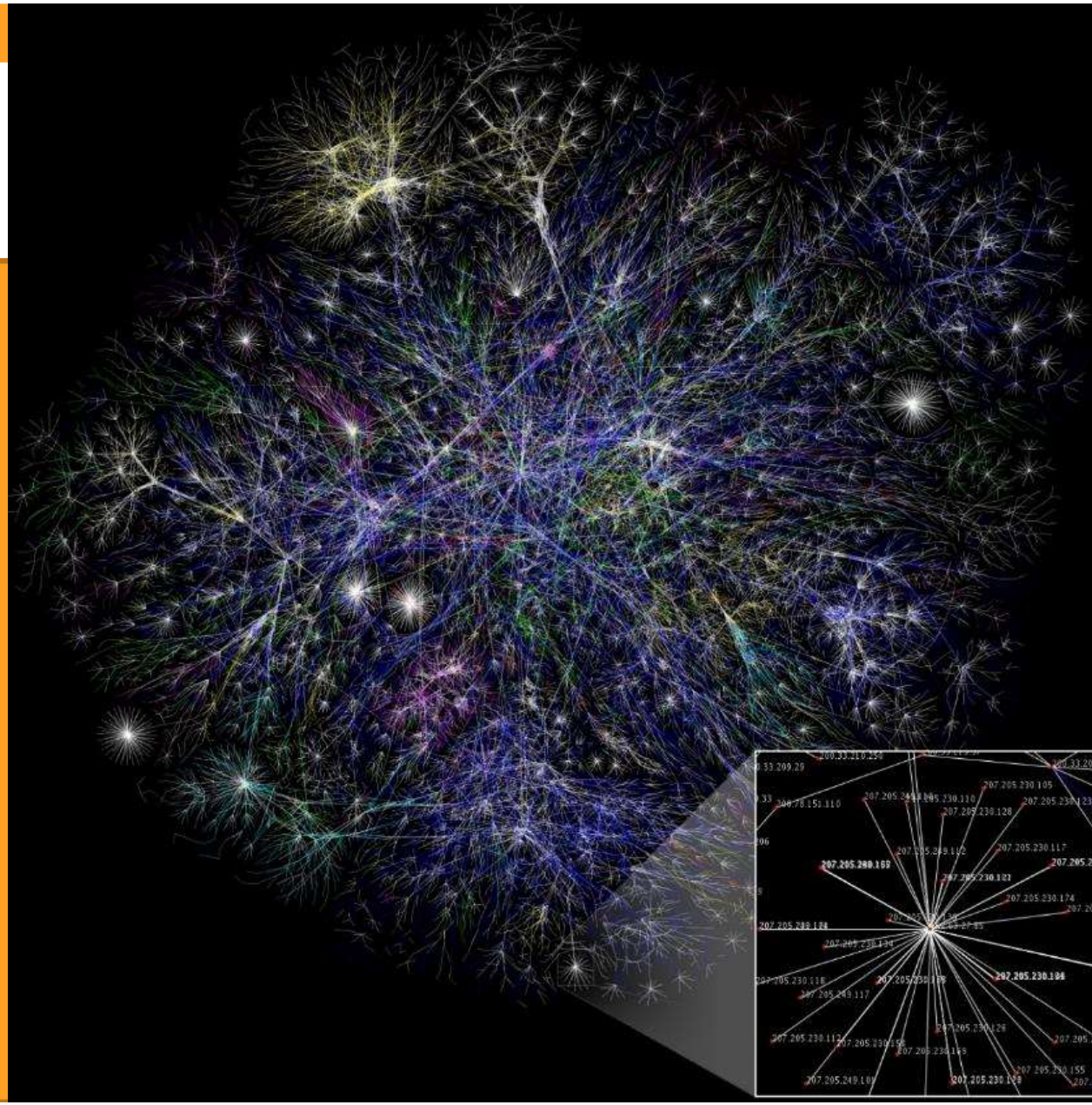
Activity

1. Use Office 365's cloud-based collaboration tools.
2. Under what conditions could OneDrive be Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)?
3. If everything becomes a subscription, then what have we got? Is the medium now the message?

Computer Networks?

Network: a set of computers connected together for the purpose of sharing resources.

Internet: a network of peer networks.

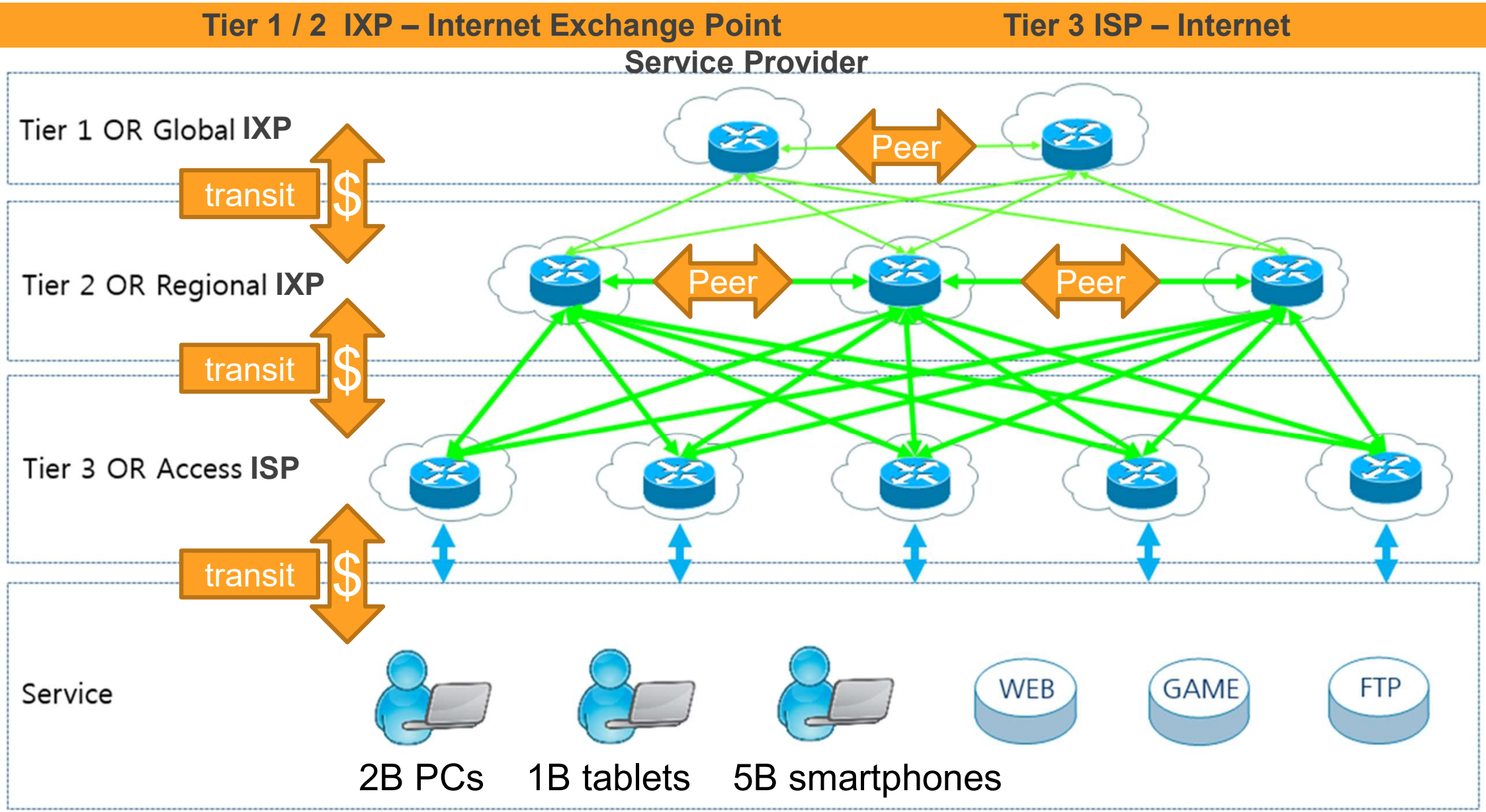


Types of Computer Networks

- **WAN** = Wide Area Network, e.g. public **Internet**
- **Intranet** = inside a private network. PCs, BYOD, servers for file + print + storage + data sharing.
  - **LAN** = high speed Local Area Network for an Intranet
  - **VPN** = Virtual Private Network – remote connection to a private intranet across a public network via IP tunnelling.
- **MAN** = Metropolitan Area Network, TTC subway station WiFi is on a MAN from BAI Communications

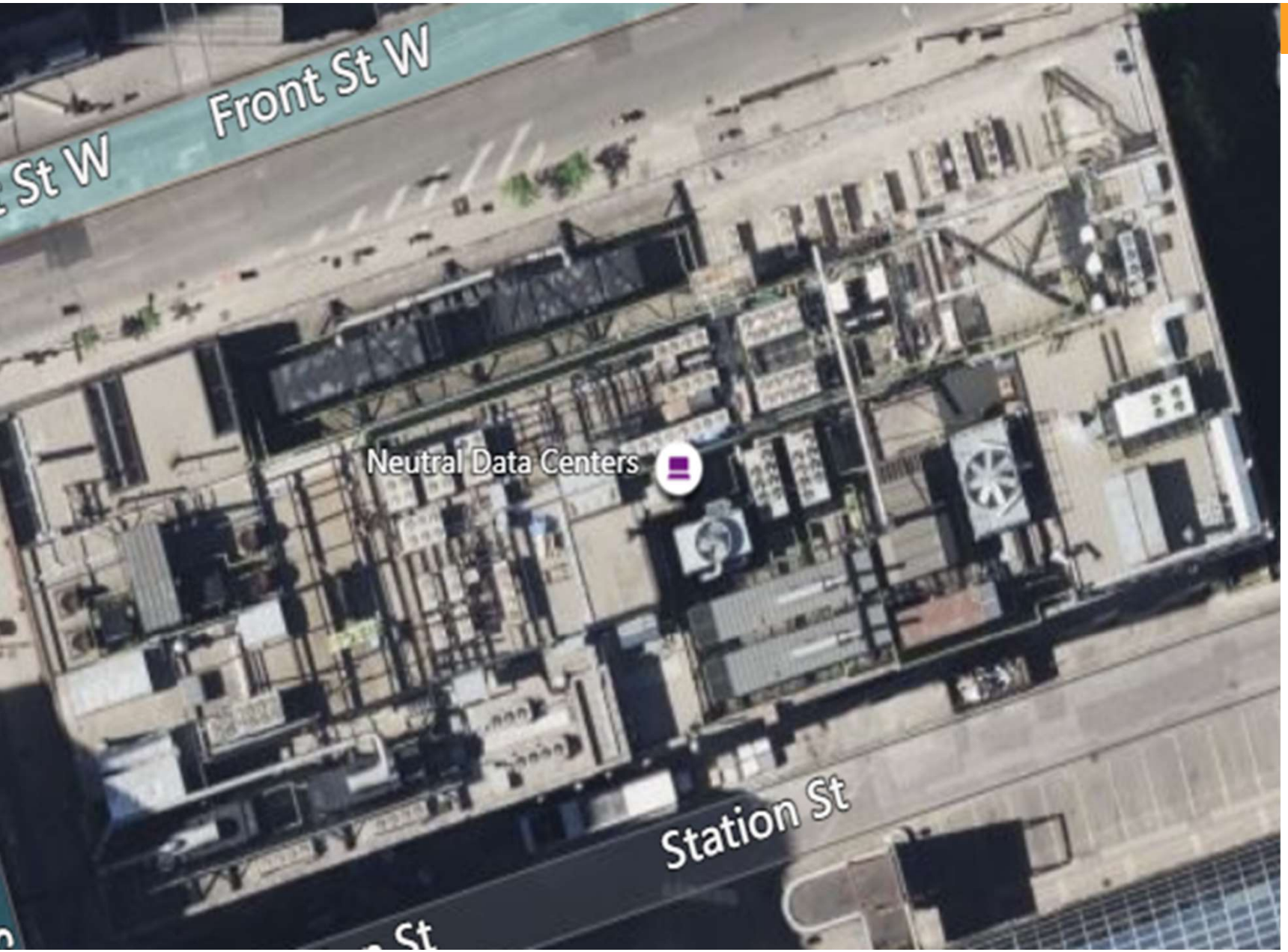
Success of the Internet

- **Open Standards**: TCP/IP, HTTP, HTML, WWW browser
  - Sir Tim Berners-Lee 1990. Marc Andreessen 1993. W3C 1994.
- **Open Source**: GNU/Linux 1991, Apache Web Server 1995
- **World-wide** networking from glass fibre & telecom goldrush
- **Affordable** bandwidth: speed + capacity grows for same $
- **Decentralized**, cooperative infrastructure. e.g. peering
  Growth by **cooperation**. Innovation by **competition**.
- **Net neutrality**: all packets are created equal


Tier 1 / 2 IXP – Internet Exchange Point
Tier 3 ISP – Internet Service Provider
Tier 1 OR Global IXP
transit
$
Peer
Tier 2 OR Regional IXP
transit
$
Peer
Peer
Tier 3 OR Access ISP
transit
$
Service
WEB
GAME
FTP
2B PCs
1B tablets
5B smartphones

TorIX carrier hotels

Tier 1 & 2 connect at **I**nternet e**X**change **P**oints (IXP) for peering and transit.

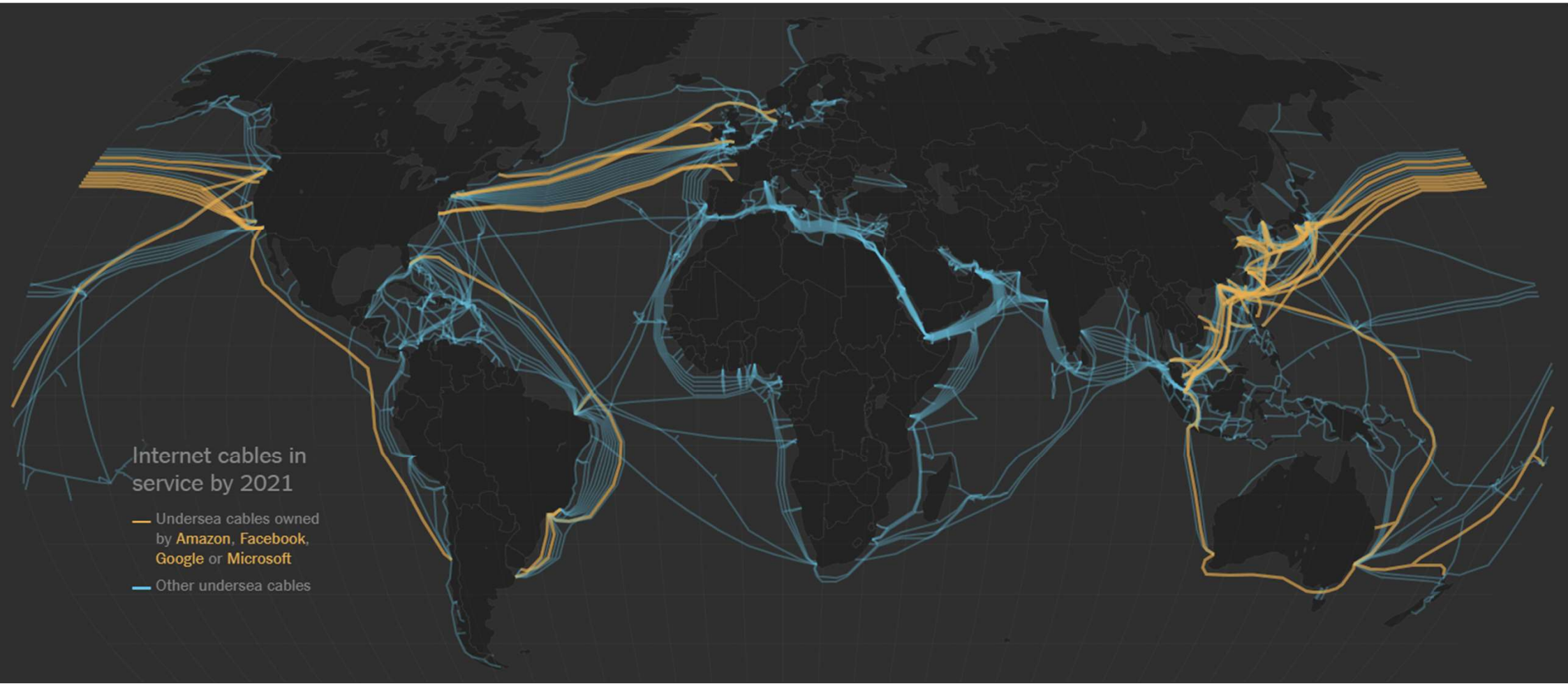


<u>151 Front St. West</u>
not a normal commercial building's rooftop

cooling towers, diesel generators, chillers, and condensers

Tier 1 & 2 Internet Exchanges

IXPs connected through the oceans



The Internet is brought to you by...

- **Browsers** (Firefox, Chrome) process JavaScript and render Internet content into a consumable form for end users
- **Search engines** (Startpage, DuckDuckGo, Google, Bing) help you discover online content
- **Content creators** author the content you see online. (Human beings who need to eat just like you do.)
- **App Platforms & Stacks** (Facebook, Shopify, Wordpress, Drupal, LAMP, ASP.NET) content deployment and dev.
- **Hosts** (matrix, Amazon Web Services, WHC.ca, Rackspace) provide infrastructure where the platforms live
- **Internet Service Providers** (ISPs) (Teksavvy, Bell, Rogers) connecting end users to the Internet (Tier 3)
- **Transit Providers** connect you from the last mile (Tier3 ISPs) to the rest of the Internet (Tier 2 & 1)
- **Reverse Proxy/CDN**[1] (Akamai, Cloudflare, AWS) provide networks to cache content and protect from attack
- **Recursive DNS**[2] providers (CIRA, Quad9, OpenDNS) cache info to resolve end users' DNS queries quickly
- **Authoritative & Root DNS** (Dyn, Cloudflare) official reference of domains, names, and related IP addresses
- **Registrars** (e.g. Tucows) registers domain names. ICANN[3] governs internationally. https://whois.icann.org/en
- **Registries** (cira.ca, Verisign) administer top level domains (TLD) .ca, .com IANA & RIR[4] govern the TLDs

[1] CDN = Content Delivery Network distributes traffic better than a single server and protects from DDoS attack

[2] DNS = Domain Name System/Services translates human usable domain names into IP addresses

[3] ICANN = Internet Corporation for Assigned Names and Numbers sets rules for Registrars and Registries

[4] IANA = Internet Assigned Numbers Authority & RIR = Regional Internet Registries provide IP addresses used by Registries and Registrars.

What are the issues of shared computing and networking?

Downasaur

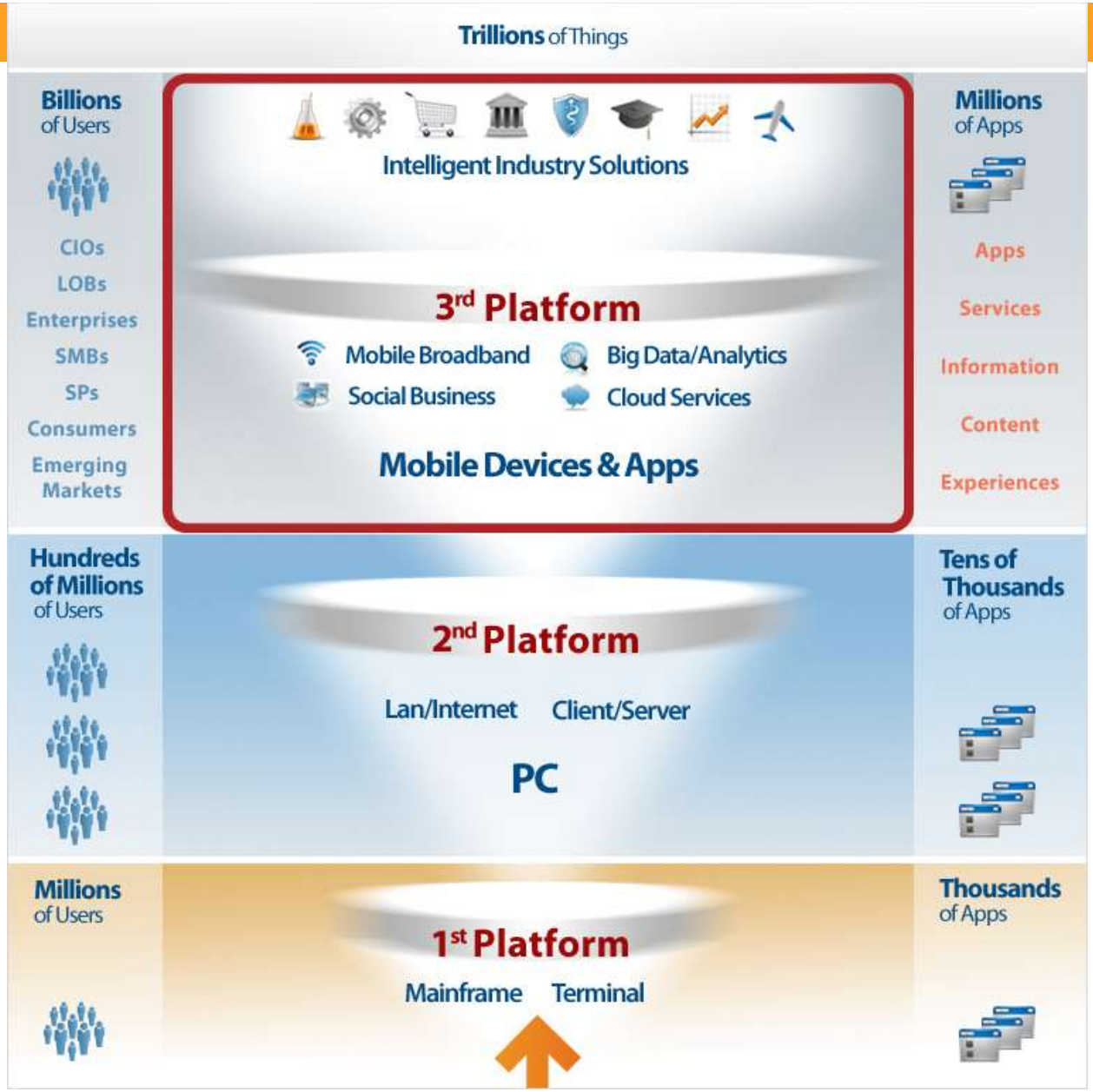
No Internet

How do you **feel** when this happens?

Try:

- Checking the network cables, modem and router
- Reconnecting to Wi-Fi

ERR_INTERNET_DISCONNECTED


Trillions of Things
Billions of Users
CIOs
LOBs
Enterprises
SMBs
SPs
Consumers
Emerging Markets
Intelligent Industry Solutions
3rd Platform
Mobile Broadband
Big Data/Analytics
Social Business
Cloud Services
Mobile Devices & Apps
Millions of Apps
Apps
Services
Information
Content
Experiences
Hundreds of Millions of Users
2nd Platform
Lan/Internet
Client/Server
PC
Tens of Thousands of Apps
Millions of Users
1st Platform
Mainframe
Terminal
Thousands of Apps

“Dumb” Terminals & Single-Tier design

The server does all thinking, processing, storing.

Terminal / Thin client interacts with user as directed by the server.

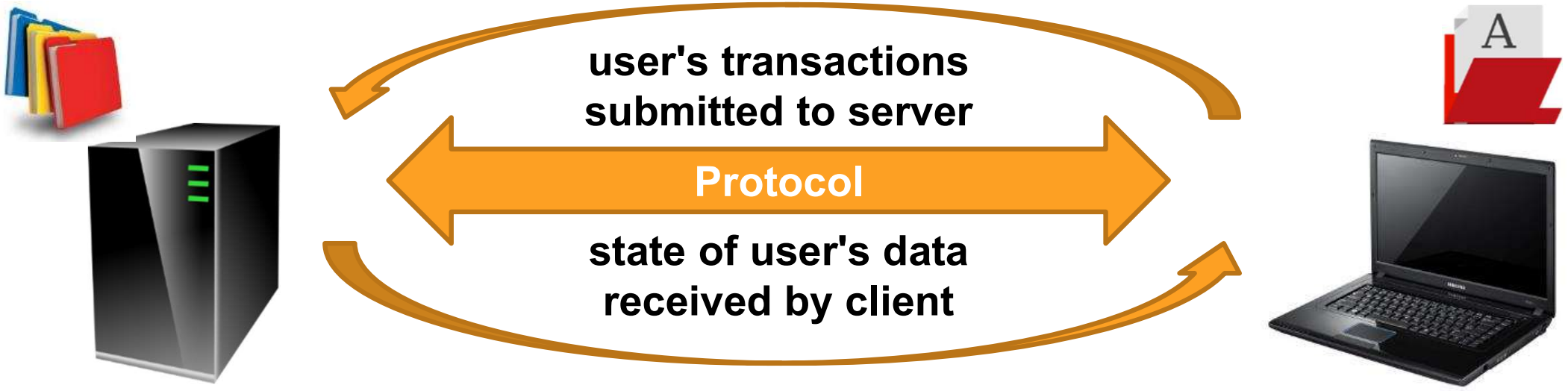
IBM 3270, 1971

DEC VT-100, 1978

Thin Client HTML5 + CSS3 + JS

Name	Value
Name	
Sex	○ Male ◉ Female
Eye color	green ▾
Check all that apply	☐ Over 6 feet tall ☐ Over 200 pounds
Describe your athletic ability:	
	Enter my information

Two-Tier design & Client–Server Model



Server/Host Business centralized: multi-user processing, data store, communication with other systems

Server		Thick Client
Streaming	←|→	Client App
App Server	←|→	s-phone App
Exchange	←|→	Outlook
Progressive Web Apps		
Back-end	←|→	Front-end

Client is User Facing distributed: advanced presentation, user data management;
tells server what to do

FTP needs Client–Server applications

Client authenticates and makes a connection

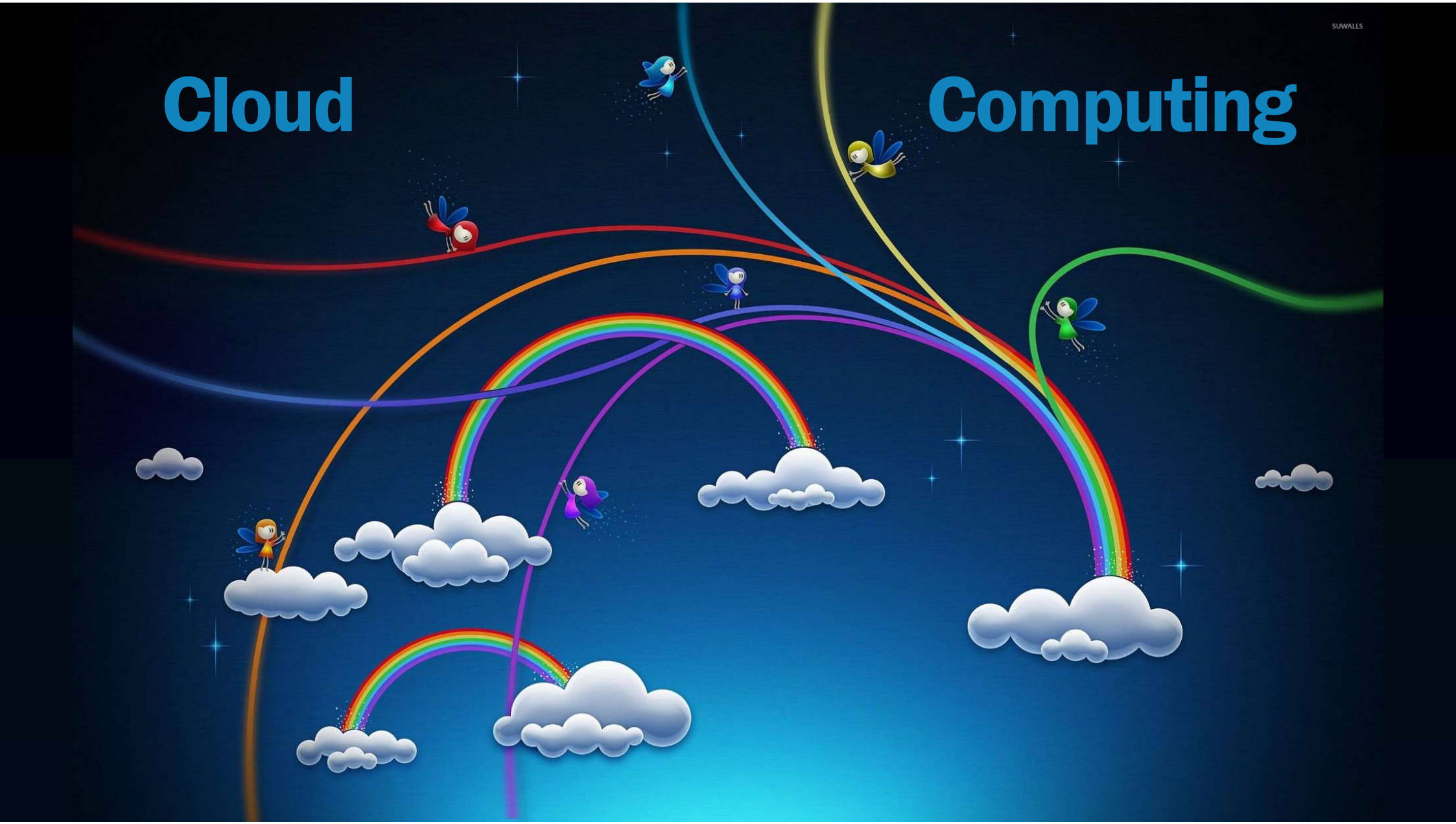
Client navigates to directories on both sides

Client requests, Server sends or accepts data

FTP Server
OS
File System
Filename
data

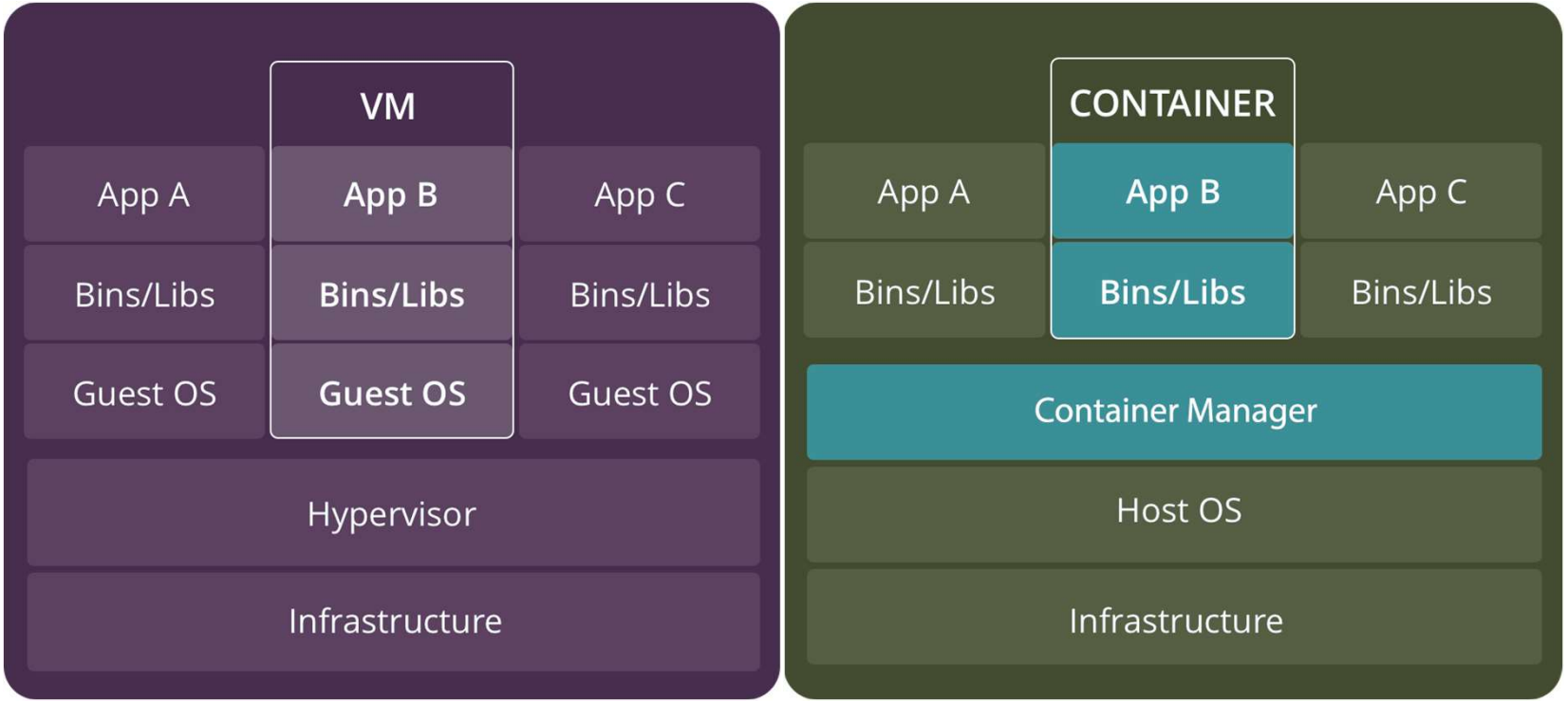
Local FTP interacts with local Operating System. Each OS maintains its own file system. File attributes/metadata are not necessarily transferred. Only *data* is exchanged between platforms.

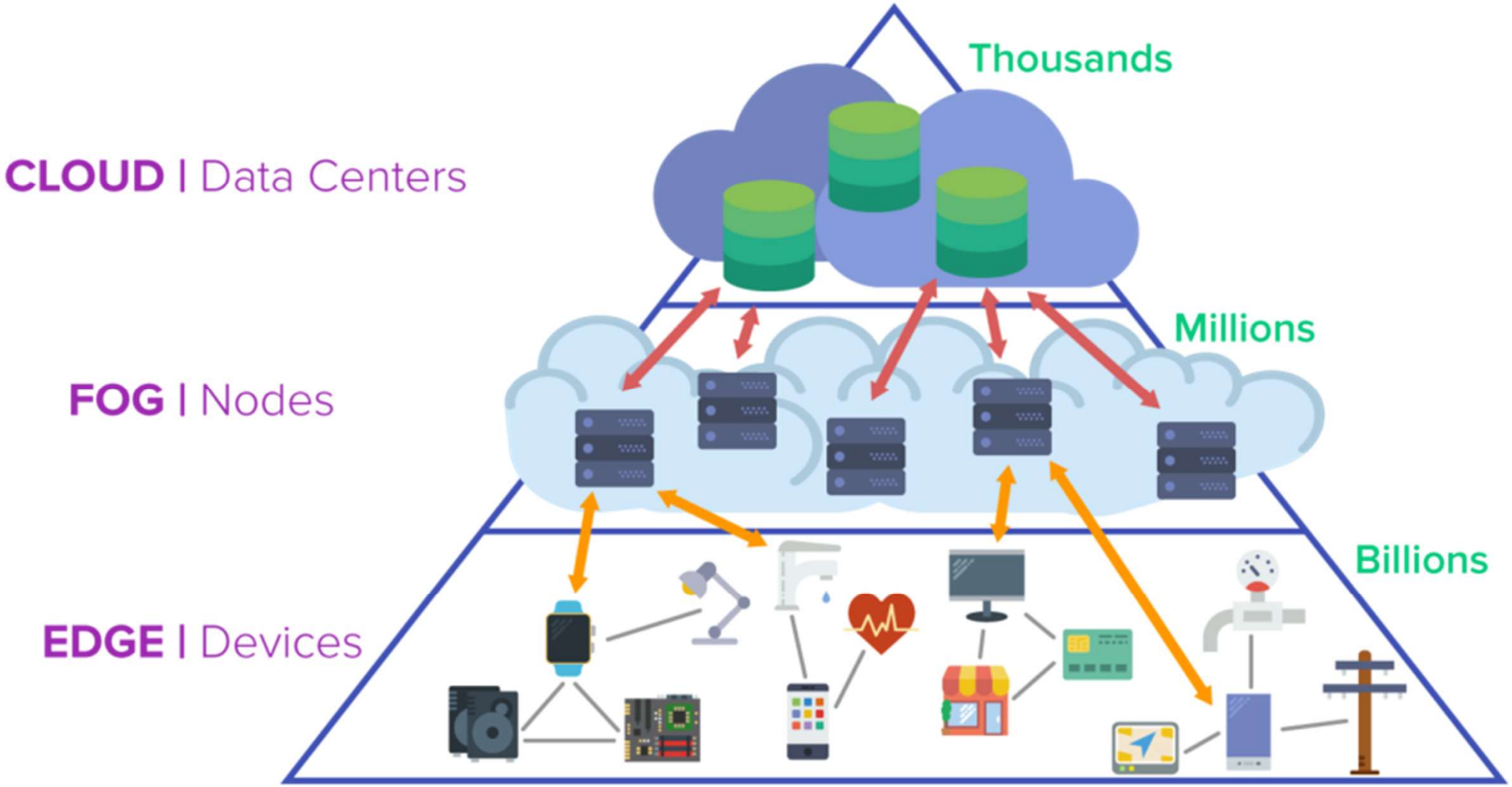
FTP Client
OS
File System
Filename
data


Cloud
Computing
SUWALLS


Servers
Desktops
Application
Content
Collaboration
Communication
Finance
Platform
Identity
Runtime
Queue
Database
Infrastructure
Block Storage
Network
Tablets
loud computing

Cloud Organization: Virtual Machines and Containers



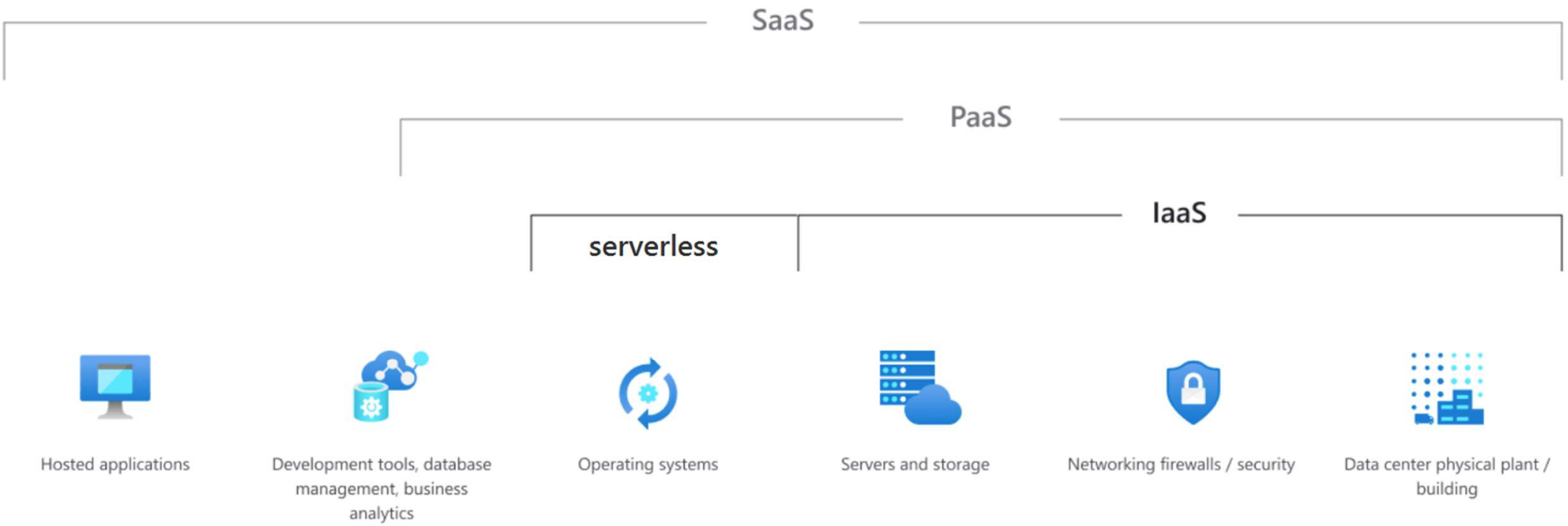

CLOUD | Data Centers
Thousands
FOG | Nodes
Millions
EDGE | Devices
Billions

Cloud Computing – thanks, Internet.

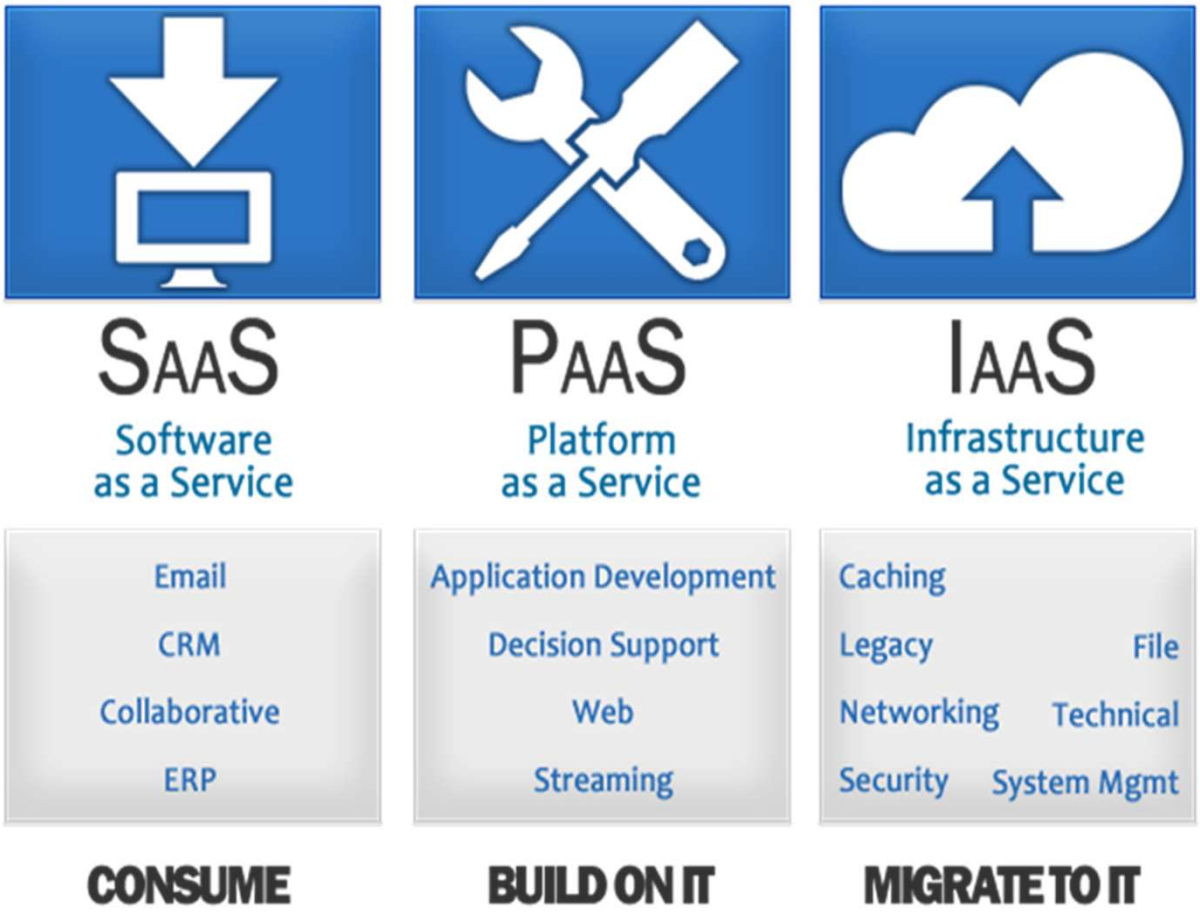
- Remote server systems store, manage, and process data for small local servers, PCs, mobile devices, web apps.
- Hosted infrastructure, development stacks, applications.
- On demand resources rapidly provisioned and released.
  - Fast start up, easy mgmt, low initial cost, scalable / elastic.
- Distributed Computing: independent systems running processes as part of a larger application controlled by messages passing between those systems.
  - Climate Prediction, Distributed Compute Labs, BitTorrent, block chain

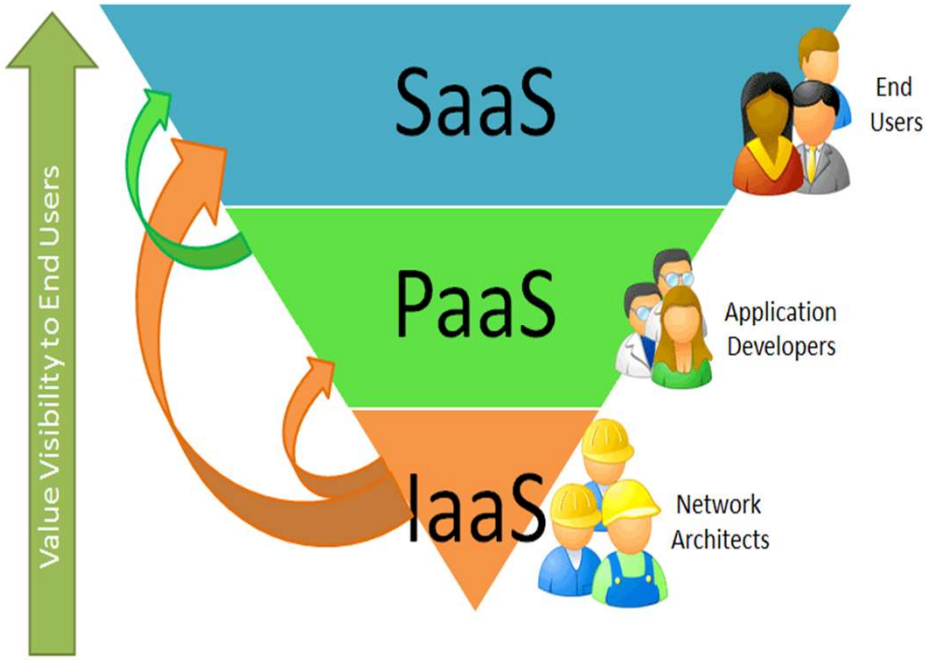
Clouds ...as a Service

Software: SaaS	Platform: PaaS	Infrastructure: IaaS
end user applications from service provider	custom development of end user applications	remote servers, storage, networking



Cloud Computing Services

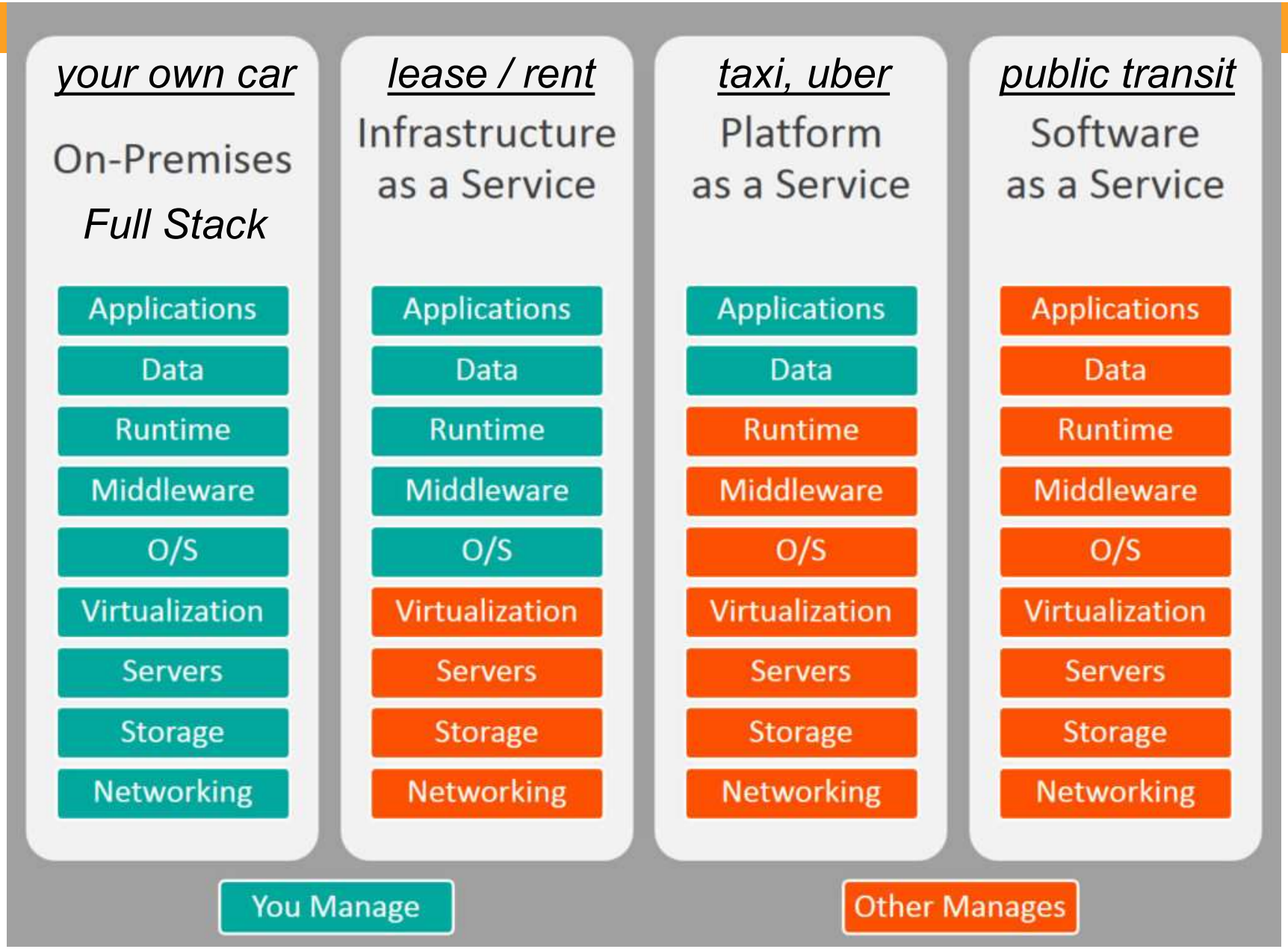




Software as a Pizza: food court pizza
Platform as a Pizza: pizzeria delivery
Infrastructure as a Pizza: pizzeria franchise

Transportation _aaS

Cloud Computing



Cloud Computing – IaaS Infrastructure as a Service

- Infrastructure as a Service provides servers, and/or secondary storage, and/or networking services.
  - "Lift-and-Shift" on-premises computing to the cloud.
- High range of scalability and elasticity
- Amazon Web Services (AWS).
  Google Compute Engine (GCP)
- e.g. your ISP is your IaaS for wide area networking.

Cloud Computing – PaaS Platform as a Service

- PaaS provides hosted software development stacks to create web applications.
  - Frameworks to build, debug, deploy, scale up/down.
  - Windows Azure runs ASP.NET web applications
  - Red Hat OpenShift on Red Hat OpenStack Platform
  - Google App Engine, Box.com
- PaaS does intelligent things with things you put there.
  - File serving: share, version, replicate, cache, synch.
  - Cloud hosted database platforms: you configure and populate.
  - APIs for web services you provide to other developers.

Cloud Computing – SaaS Software as a Service

- Software as a Service is an **application** delivered over a network / Internet.
  Companies run (a part of) their business on the service's software.
  Users access the application remotely on smartphones, tablets, browsers.
- SalesForce CRM – the original SaaS for the front-office
- Back office SaaS – Payroll, Purchasing, Accounts Payable, Inventory and Billing, Accounts Receivable, General Ledger.
- Google Apps, Microsoft Office 365, BigBlueButton
- Streaming services for consumers
- eLearning: Cloud Computing Types
  - eLearning Tutorials Login needs Seneca *and* LinkedIn accounts

Peer to Peer and Blockchain need networks

- A peer-to-peer (P2P) network is two or more systems sharing resources without using a central server (no central authority). BitTorrent protocol for file sharing
- Advantages: low cost, easy to install, and no need for skilled staff, expensive servers, high bandwidth
- Disadvantages: difficulty of administration, issues of security + trust, performance, scalability, reliability
  - Blockchain addresses security + trust

What is the impact of technology?

Technology disrupts the ecology of space and time, even human relationships.

When you move bits instead of atoms, things *change*.

A high bandwidth, generally reliable Internet enabling streaming services/subscriptions are examples.

Notes – not on the quiz

background info
in following notes
~ not on the quiz ~

https://ocs.transunion.ca/heavy-load.html

MENU

TransUnion® Online Consumer Solutions

The Online Consumer Disclosure For Canadians

The site is currently under heavy load

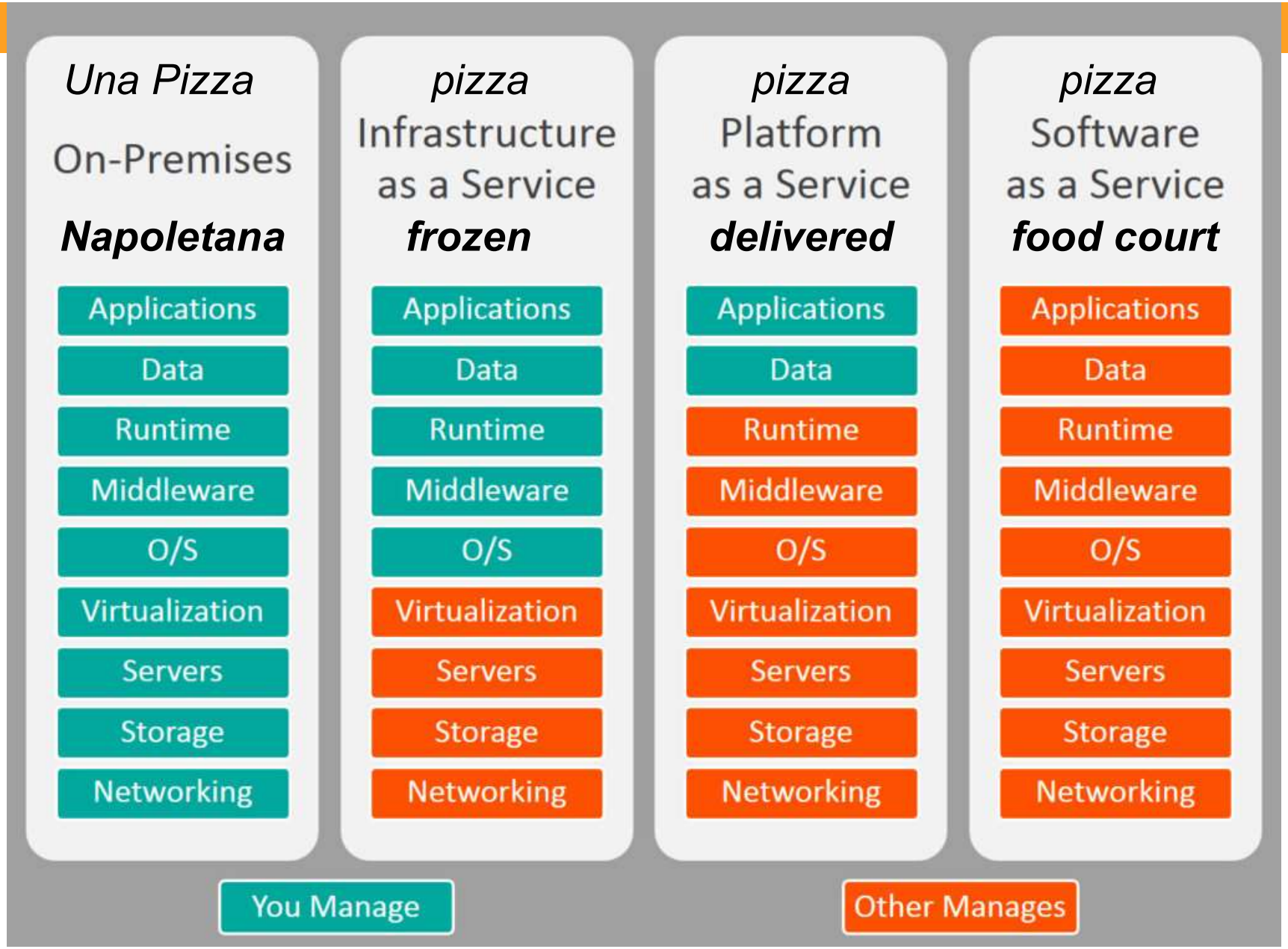
WHY IS THIS THE USER'S PROBLEM?
It indicates a system that does not "scale".
It could also be a deliberate throttling of resources to ensure minimal contact with pesky, time-consuming users.

Unfortunately the site is currently under heavy load. Please try again later.

TransUnion

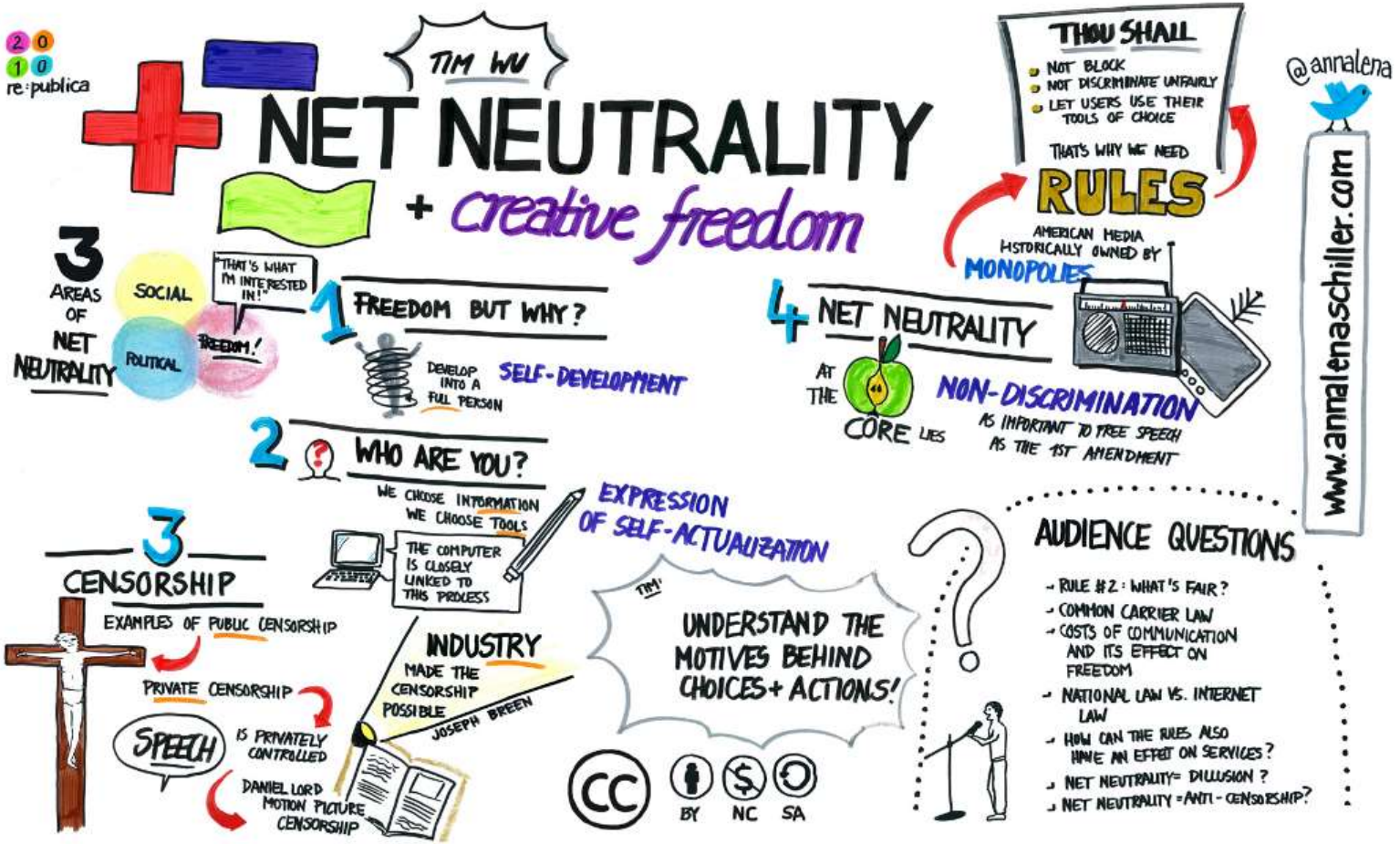
Privacy Policy Terms of Use Accessibility

Pizza Tech Stack



Pizza as a Service

Net Neutrality (Tim Wu, 2003)



Principle of an open, neutral Internet: Internet providers do not use their privileged position to favour some applications and services over others.

All packets are equal.


THIS COULD BE THE INTERNET WITHOUT NET NEUTRALITY.
PACK 1
$5
MONTH
GET ACCESS TO:
PACK 2
$10
MONTH
GET ACCESS TO:
PACK 3
$15
MONTH
GET ACCESS TO:
PACK 4
$20
MONTH
GET ACCESS TO:
PACK 5
$30
MONTH
GET ACCESS TO:
+
UNLIMITED
$100
MONTH
GET ACCESS TO EVERYTHING

Is sharing music/video files illegal?

© Copyright in Canada as of 2012:

- Bill C-11, the Copyright Modernization Act, allows for private and personal use of time shifting, format shifting, and backup copies **as long as no digital locks are involved**.
- online infringement of © — “notice-and-notice”
  - “notice-and-takedown” in USA and EU

File Sharing

- File Sharing is the practice of or ability to transmit files from one computer to another over a network or the Internet.
- File sharing is the public or private sharing of computer data on a network, so that multiple people can access the data to their level of access privilege.
- File sharing makes collaboration easier, but is also used for the illegal distribution of music, movies, software, and pornography.

File Sharing: Napster vs BitTorrent