Some Recap and Minor contents

ACKNOWLEDGEMENTS

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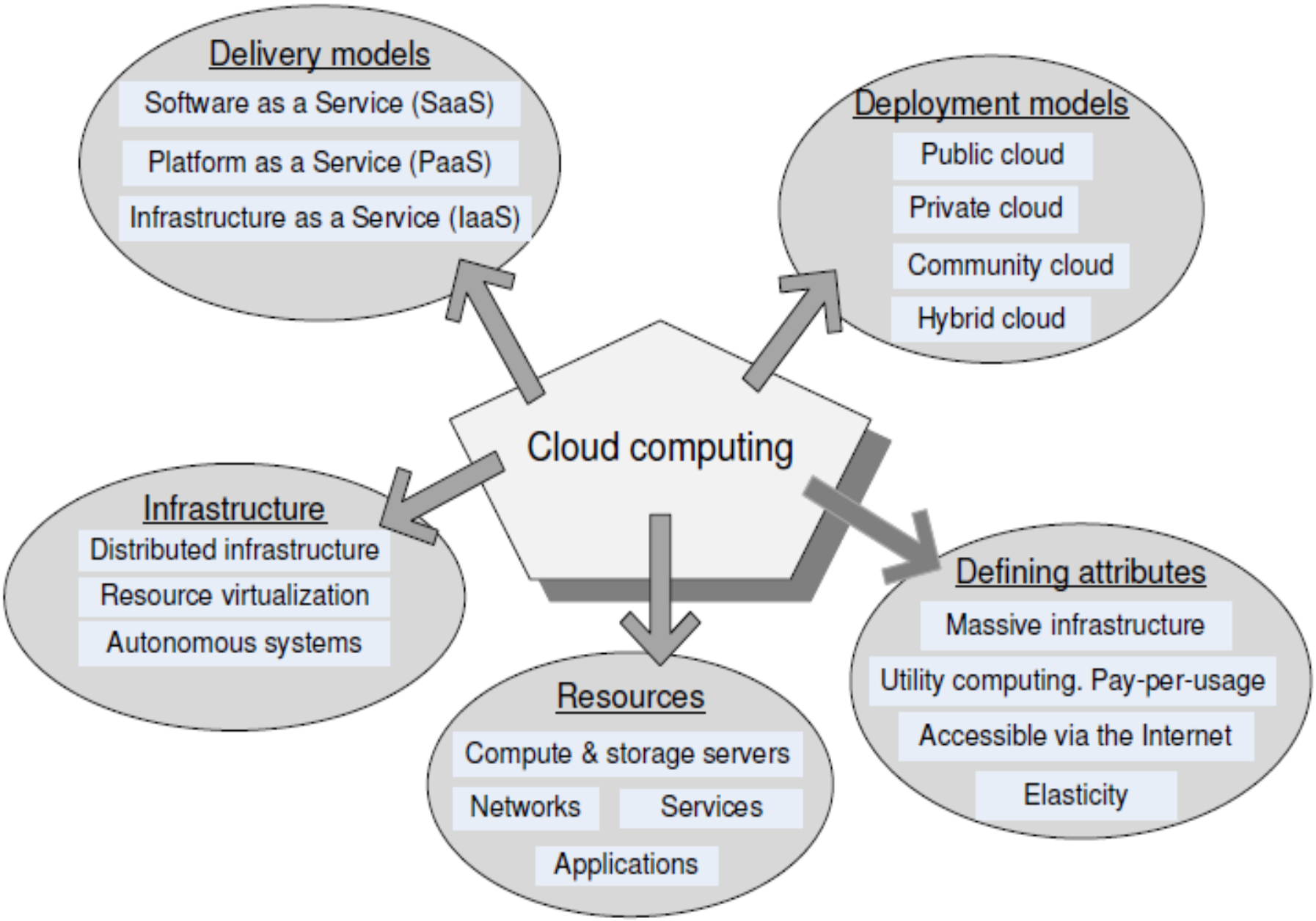
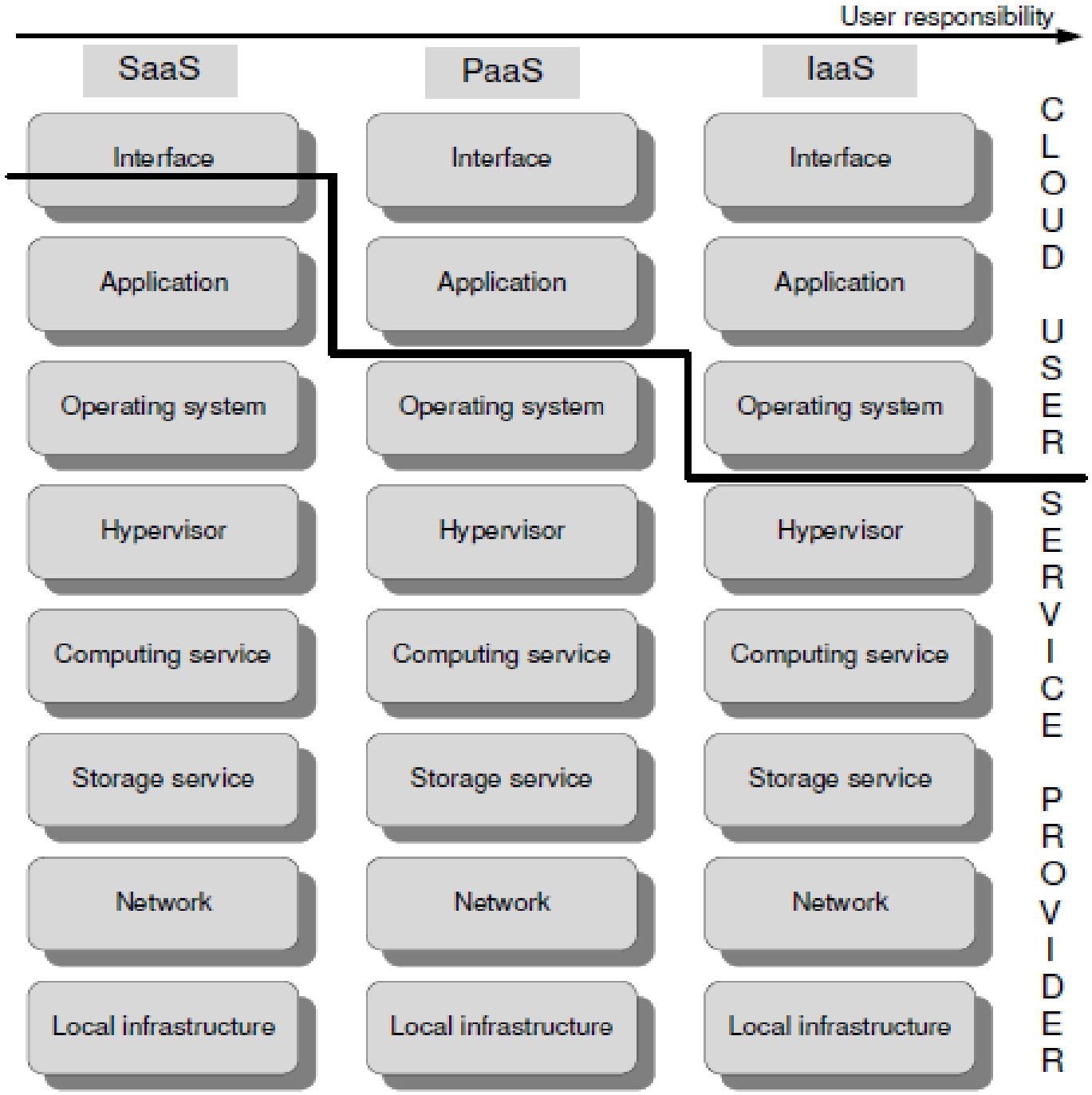
- The presenter is grateful to the authors of those various sources.
- The presenter acknowledge the efforts of those authors and thank them wholeheartedly.

SUMMARY


Delivery models
Software as a Service (SaaS)
Platform as a Service (PaaS)
Infrastructure as a Service (IaaS)
Deployment models
Public cloud
Private cloud
Community cloud
Hybrid cloud
Cloud computing
Infrastructure
Distributed infrastructure
Resource virtualization
Autonomous systems
Resources
Compute & storage servers
Networks
Services
Applications
Defining attributes
Massive infrastructure
Utility computing. Pay-per-usage
Accessible via the Internet
Elasticity


User responsibility
SaaS
PaaS
IaaS
Interface
Application
Operating system
Hypervisor
Computing service
Storage service
Network
Local infrastructure
Interface
Application
Operating system
Hypervisor
Computing service
Storage service
Network
Local infrastructure
Interface
Application
Operating system
Hypervisor
Computing service
Storage service
Network
Local infrastructure
CLOUD USER
SERVICE PROVIDER

Cloud computing

- The control is relinquished to third party services;
- The data is stored on multiple sites administered by several organizations; and
- Multiple services interoperate across the network

Cloud Computing

- Risks:
  - Unauthorized access,
  - data corruption,
  - infrastructure failure, and
  - service unavailability
- *de-perimeterisation*
  - Systems can span the boundaries of multiple organizations and cross the security borders.
    - border of (a) organizations IT infrastructure blurs (b) the accountability becomes less clear

Cloud Computing

- Cultural differences:
  - Privacy: Some favor privacy, other may not.
- Tackling such various ethical issues
  - rules and regulations for the governance of cloud computing –
  - Improved accountability
  - Overcome Vendor Lock-in.

Cloud Security Concerns

- Potential loss of control/ownership of data.
- Data integration, privacy enforcement, data encryption.
- Data remanence after de-provisioning.
- Multi tenant data isolation.
- Data location requirements within national borders.
- Hypervisor security.
- Audit data integrity protection.
- Verification of subscriber policies through provider controls.
- Certification/Accreditation requirements for a given cloud service.

Top services or applications moving to the cloud:*

Small business

1. Storage (40%)
2. Conferencing & collaboration (37%)
3. Messaging (36%)

Medium business

1. Storage (35%)
2. Messaging (33%)
3. Office & productivity suites (32%)

Large business

1. Conferencing & collaboration (40%)
2. Storage/business process apps (35%)
3. Messaging/ compute power (34%)

Federal govt.

1. Conferencing & collaboration (39%)
2. Messaging (37%)
3. Business process apps (31%)

State/local govt.

1. Storage (19%)
2. Conferencing & collaboration (17%)
3. Messaging/business process apps/ compute power (15%)

Healthcare

1. Conferencing & collaboration (29%)
2. Compute power (26%)
3. Office & productivity suites (22%)

Higher education

1. Storage (31%)
2. Messaging/ conferencing & collaboration (29%)
3. Compute power (25%)

K-12

1. Storage (40%)
2. Conferencing & collaboration (36%)
3. Office & productivity suites (33%)

*Those who are migrating or have migrated

5 Reasons Businesses Use the Cloud

Every year, more and more businesses are adopting cloud. While traditionally thought of as an IT decision, cloud is increasingly being considered a business decision to enable company functions. Take a look at five reasons why more businesses are adding the cloud to their technology arsenals.

1 It offers better insight and visibility

Businesses are using cloud technology to support their analytics efforts. Of leading organizations:

54% use analytics extensively to derive insights from big data

59% use cloud to share data seamlessly across applications

59% intend to use cloud to access and manage big data in the future

2 It makes collaboration easy

Cloud allows work to be accessed from anywhere on multiple devices, making cross-functional collaboration much easier. Here's what leading organizations—those that are gaining competitive advantage through cloud—cited as popular uses:

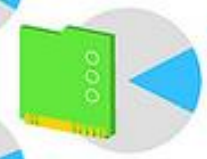
58% collaborate across the organization and ecosystem

59% improve integration between development and operations

3 It can support a variety of business needs

Companies are forging a tighter link between technology and business outcomes. Take a look at the business functions companies have migrated to the cloud.

18% messaging



15% storage

13% office/productivity suites

4 It allows for rapid development of new products and services

The cloud offers businesses valuable capabilities. Here's what leading organizations say it enables them to do:

52% use it to innovate products & services rapidly

24% are able to offer additional products & services

5 The results are proven

From business growth to increased efficiency, businesses using cloud are realizing benefits across the company.

25% of businesses saw a reduction in IT costs

55% saw an increase in efficiency

49% saw improvement in employee mobility

Sources: CDW, IBM Center for Applied Insights

When Public Cloud may not be Ideal

- Sensitive data such as employee and health care records.
- Multiple co-dependent services, e.g., online transaction processing.
- Third party software without cloud licensing.
- Workloads requiring auditability and accountability.
- Workloads requiring customization.

Some Examples….

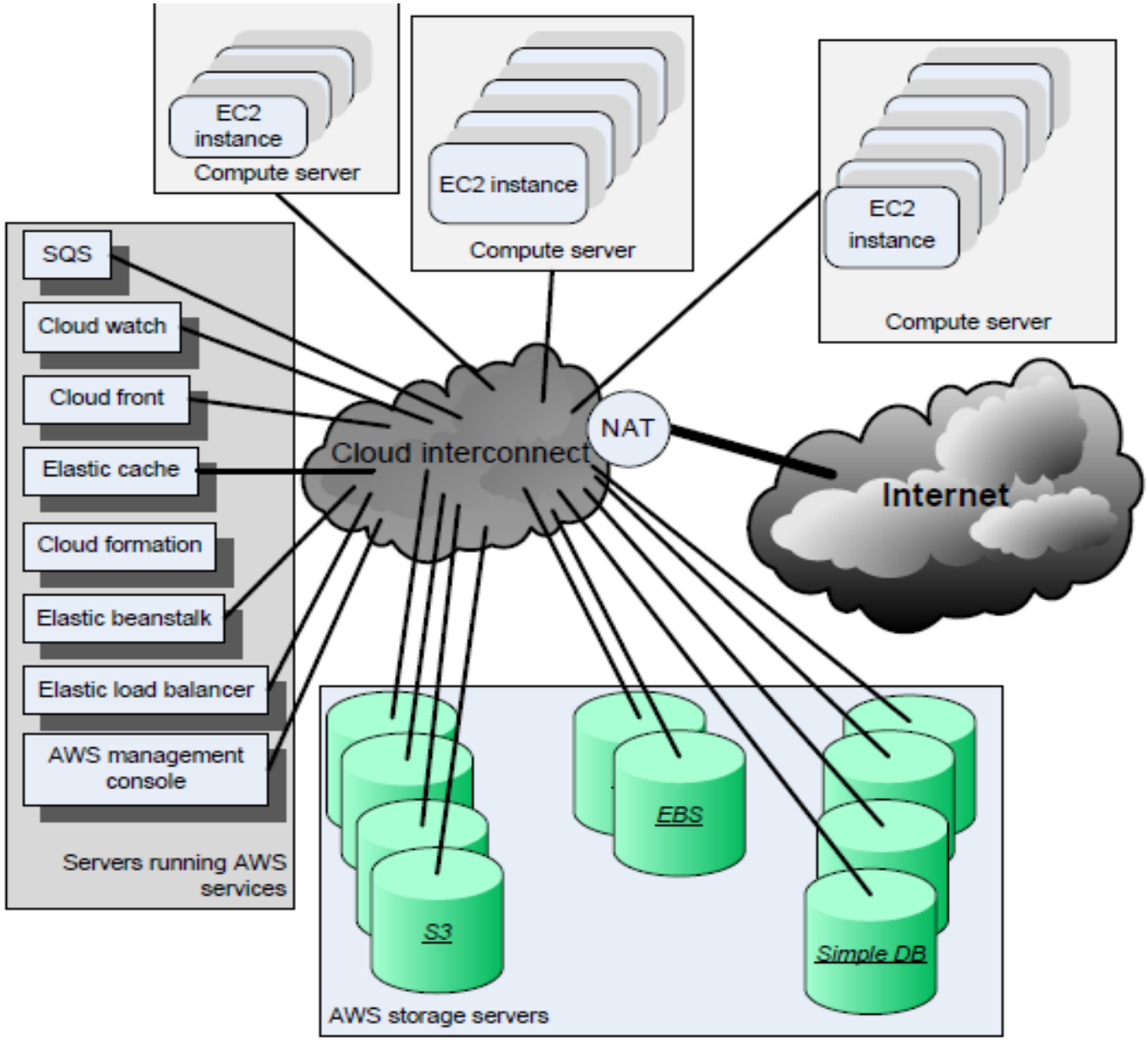
EXISTING CLOUD INFRASTRUCTURES

Existing cloud infrastructure

- Most of them you will be doing as part of your internal assessment.
- The cloud computing infrastructure at Amazon, Google, and Microsoft (as of mid 2012).
  - Amazon is a pioneer in Infrastructure-as-a-Service (IaaS).
  - Google's efforts are focused on Software-as-a-Service (SaaS) and Platform-as-a-Service (PaaS).
  - Microsoft is involved in PaaS.
- Private clouds are an alternative to public clouds. Open-source cloud computing platforms such as:
  - Eucalyptus,
  - OpenNebula,
  - Nimbus,
  - OpenStack

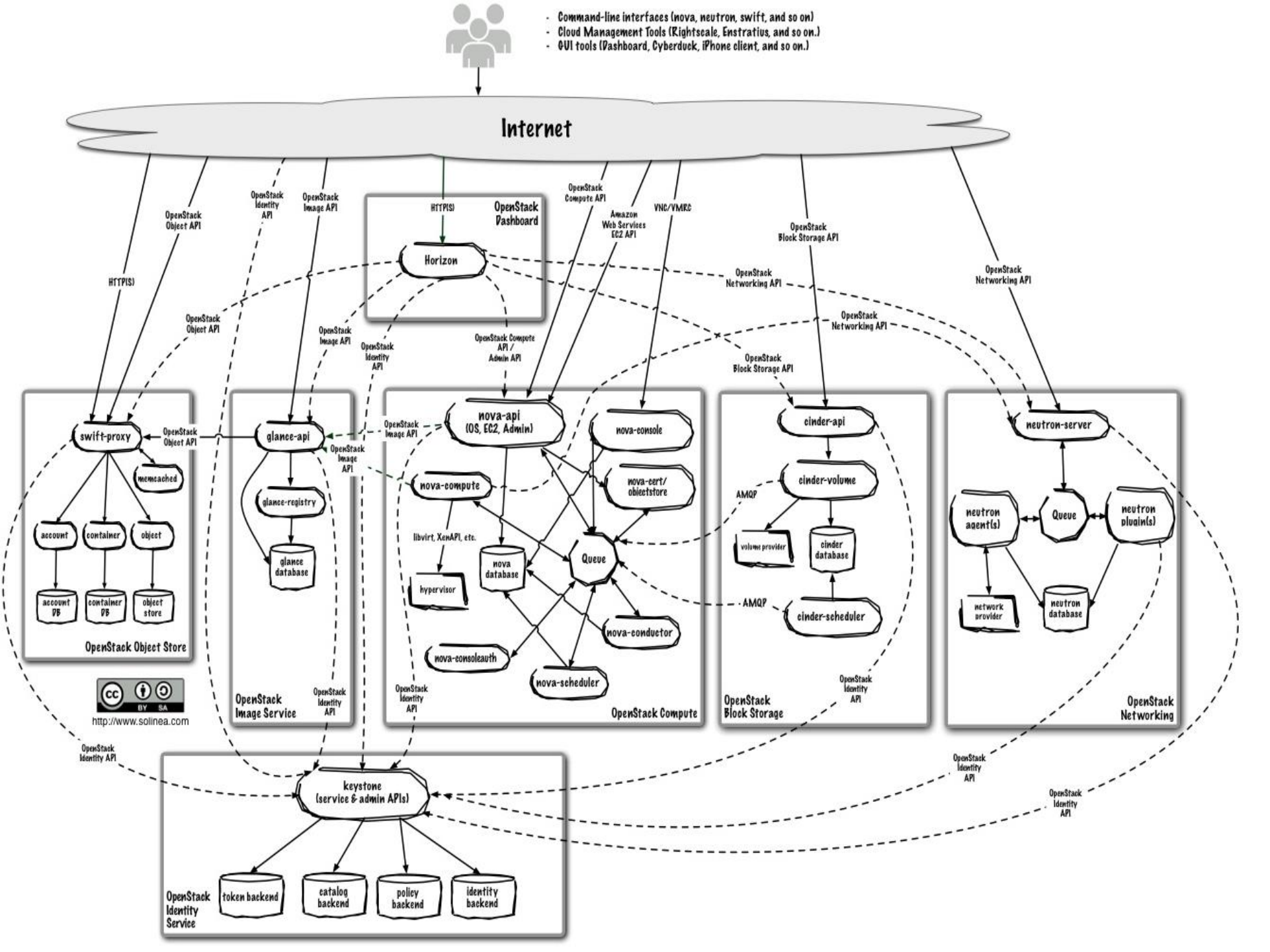
can be used as a control infrastructure for a private cloud.

Amazon Web Services



Amazon Web Services

- *AWS Management Console* - allows users to access the services offered by AWS .
- *Elastic Cloud Computing (EC2)* - allows a user to launch a variety of operating systems.
- *Simple Queuing Service (SQS)* - allows multiple *EC2* instances to communicate with one another.
- *Simple Storage Service (S3)*, *Simple DB*, and *Elastic Bloc Storage (EBS)* - storage services.
- *Cloud Watch* - supports performance monitoring.
- *Auto Scaling* - supports elastic resource management.
- *Virtual Private Cloud* - allows direct migration of parallel applications.


- Command-line interfaces (nova, neutron, swift, and so on)
- Cloud Management Tools (Rightscale, Enstratius, and so on.)
- GUI tools (Dashboard, Cyberduck, iPhone client, and so on.)
Internet
HTTP(S)
OpenStack Dashboard
Horizon
OpenStack Object API
OpenStack Identity API
OpenStack Image API
OpenStack Compute API
Amazon Web Services EC2 API
VNC/VMRC
OpenStack Block Storage API
OpenStack Networking API
OpenStack Compute API / Admin API
swift-proxy
memcached
account
container
object
account DB
container DB
object store
OpenStack Object Store
glance-api
glance-registry
glance database
OpenStack Image Service
nova-api (OS, EC2, Admin)
nova-console
nova-cert/ objectstore
nova-compute
libvirt, XenAPI, etc.
hypervisor
nova database
Queue
nova-conductor
nova-consoleauth
nova-scheduler
OpenStack Compute
cinder-api
cinder-volume
AMQP
volume provider
cinder database
cinder-scheduler
OpenStack Block Storage
neutron-server
neutron agent(s)
Queue
neutron plugin(s)
network provider
neutron database
OpenStack Networking
http://www.solinea.com
keystone (service & admin APIs)
token backend
catalog backend
policy backend
identity backend
OpenStack Identity Service

Software Licensing

- When a user requests a license from the license service..
  - the terms of the license usage are negotiated and they are part of a Service Level Agreement document.
- There are quite a few issues related to software licensing.
  - Ex: authorization
    - certificate of an authority.

Software Licensing

- The *Software-as-a-Service (SaaS)* deployment model is gaining acceptance as it allows users to pay only for the services they use.
- There is a significant pressure to change the traditional software licensing and find non-hardware based solutions for cloud computing
  - interest in alternative schemes
  - *SmartLM* research project
  - *elasticLM*
    - provides license and billing Web-based services

Software Licensing

- Elastic LM
  - Multiple layers
    - Co-allocation,
    - authentication,
      - authenticates communications between the license service and the billing service as well as the individual applications
    - administration,
    - management,
      - ordinates different components of the automated billing service.
    - business, and
      - provide the licensing service with the licenses prices
    - Persistency
      - stores the usage records

ENERGY

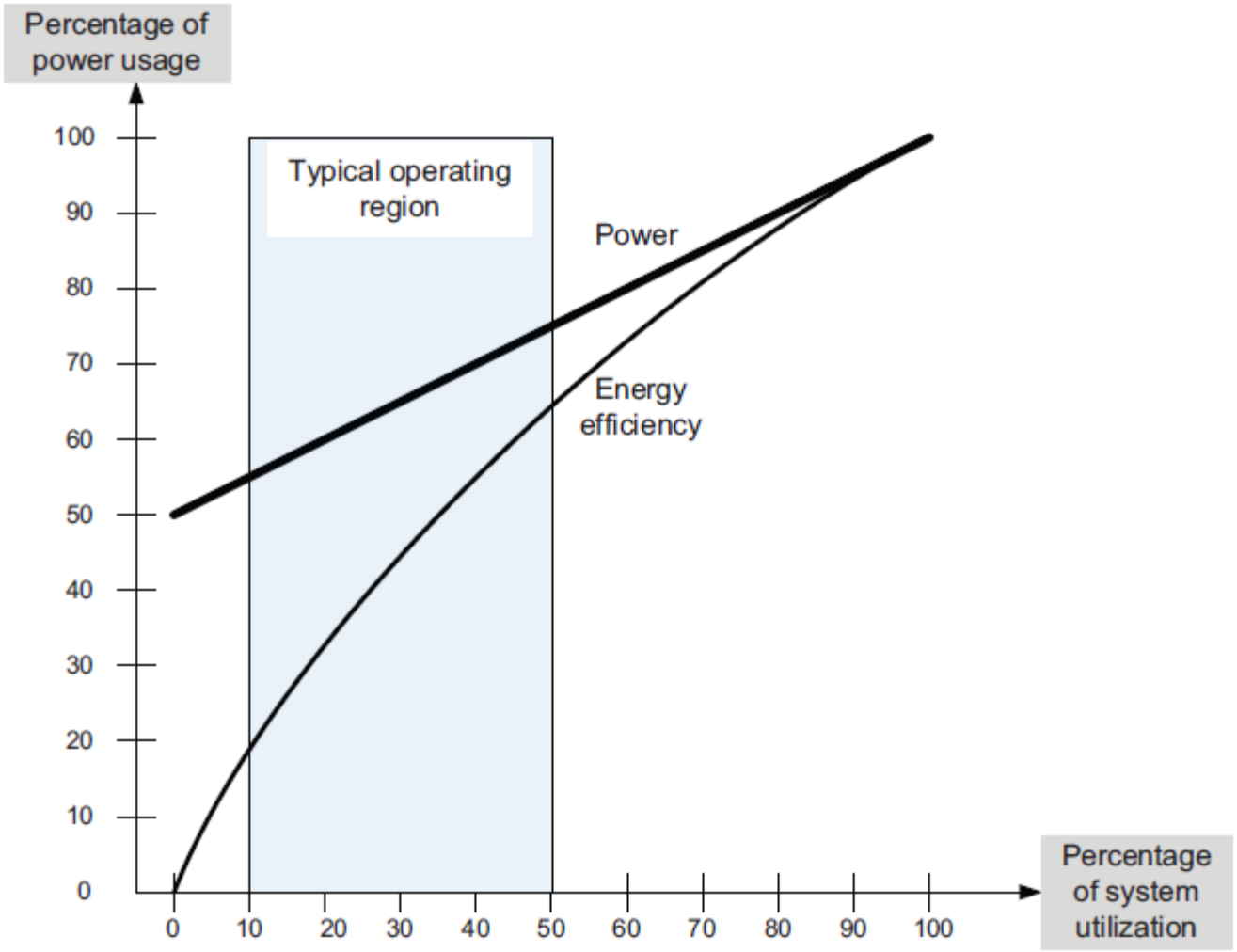
energy-proportional systems

- Concept that could lead to large savings in energy.
- Concentrating the load on a subset of servers and switch the rest of them to a standby mode whenever possible.
- Reduce the power consumption
- Operating efficiency of a system
  - performance per Watt of power.
  - performance of supercomputers has increased 7 000% while operating efficiency has increased only 2 000%.

Energy Proportional System

- Humans are a good approximation of an ideal energy proportional system!!!
- consumes no power when idle, (~70)
- very little power under a light load and (~120)
- gradually, more power as the load increases. (~1000-2000)
- Different subsystems of a computing system behave differently in terms of energy efficiency.

Energy Usage



Energy Proportional Networks

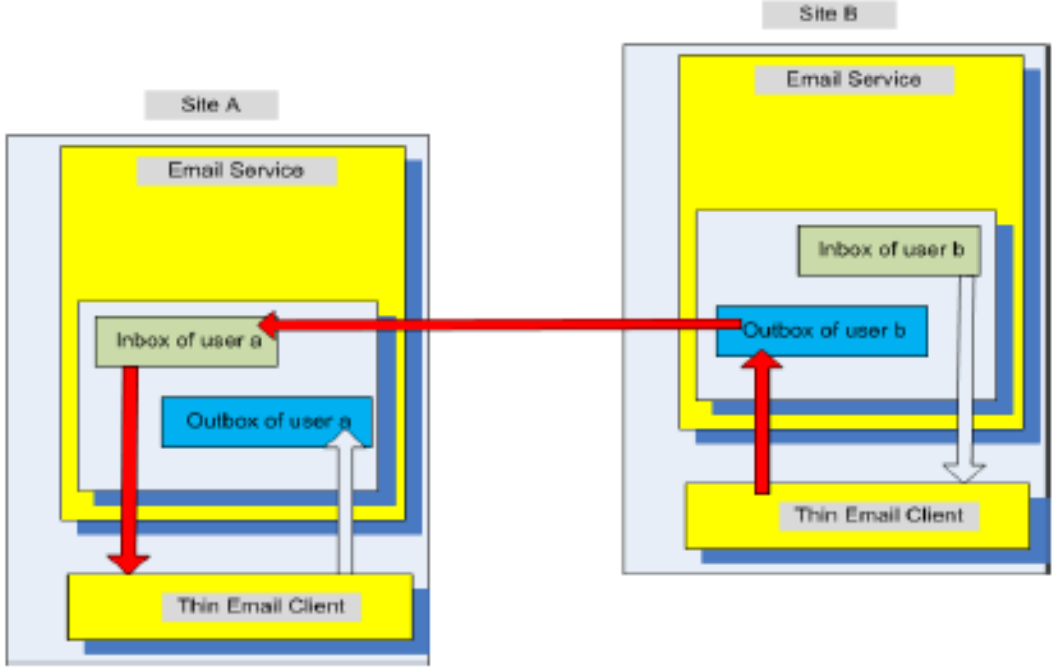
- The energy consumed by such networks is proportional with the communication load.
  - An example of an energy proportional network is *InfiniBand*
    - communications link with a switched fabric topology designed to be scalable
    - allows links to be configured for a specified speed and width
    - used to connect compute nodes with storage servers.
    - has high throughput, low latency, and supports quality of service guarantees

CLIENT-SERVER PARADIGM

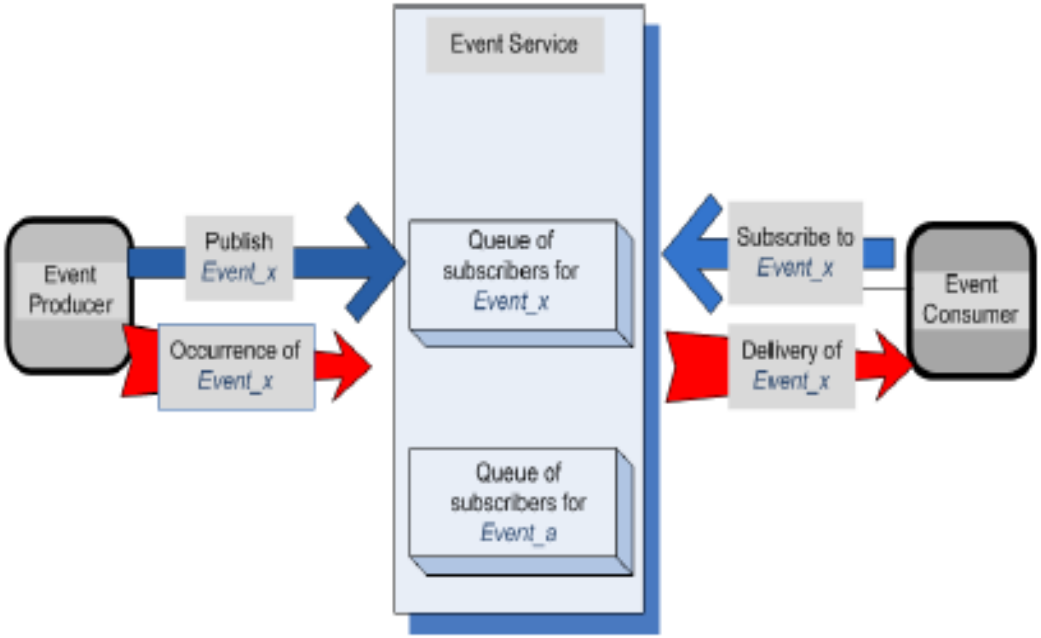
The client-server paradigm

- Based on enforced modularity
  - the modules are forced to interact only by sending and receiving messages.
- This paradigm leads to:
  - A more robust design, the clients and the servers are independent modules and may fail separately.
  - The servers are stateless, they do not have to maintain state information; the server may fail and then come up without the clients being affected or even noticing the failure of the server.
  - An attack is less likely because it is difficult for an intruder to guess the format of the messages or the sequence numbers of the segments, when messages are transported by TCP.

- (a) Email service; the sender and the receiver communicate asynchronously using inboxes and outboxes. Mail demons run at each site.
- (b) An event service supports coordination in a distributed system environment. The service is based on the publish-subscribe paradigm; an event producer publishes events and an event consumer subscribes to events. The server maintains queues for each event and delivers notifications to clients when an event occurs.



(a)

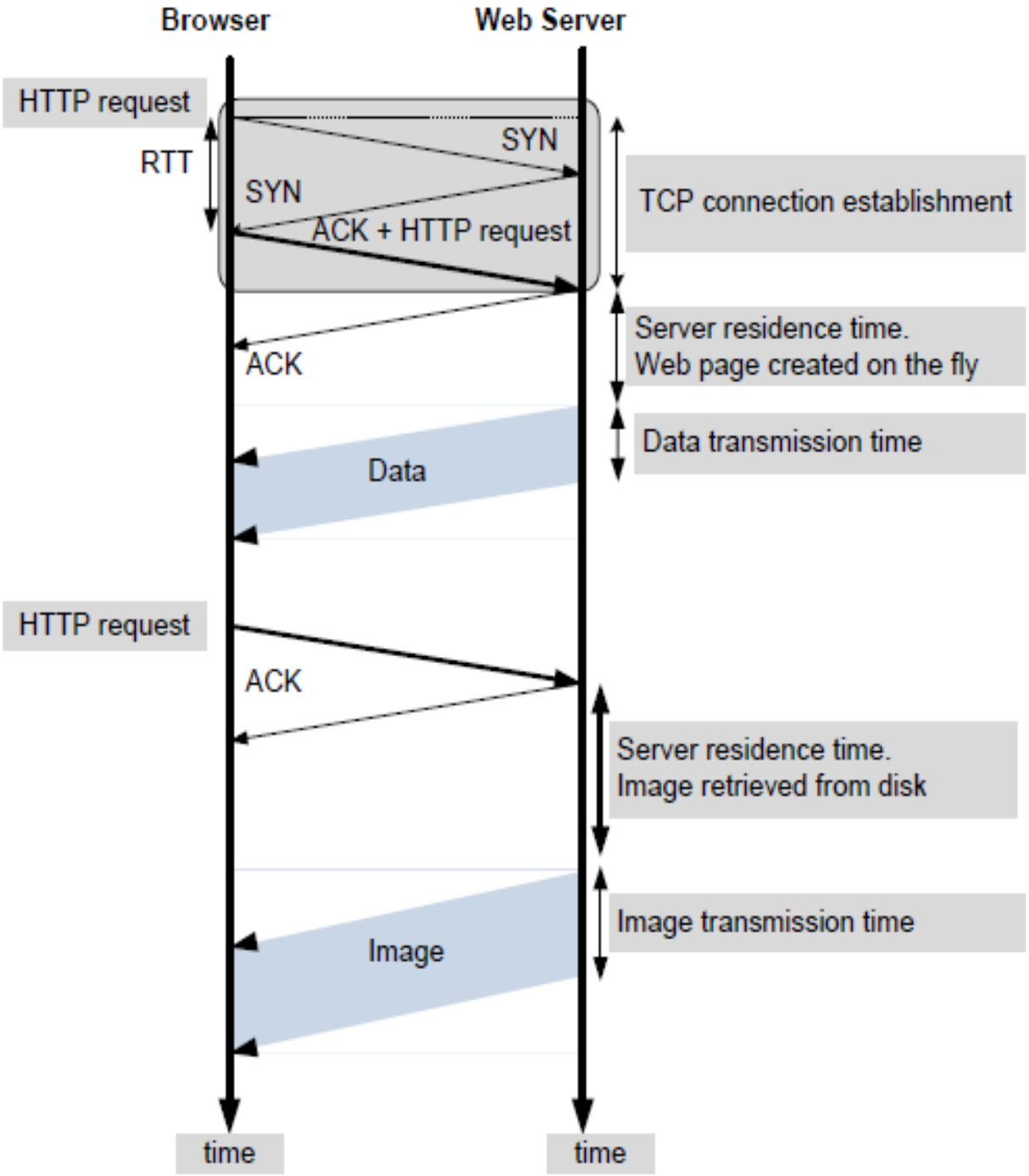


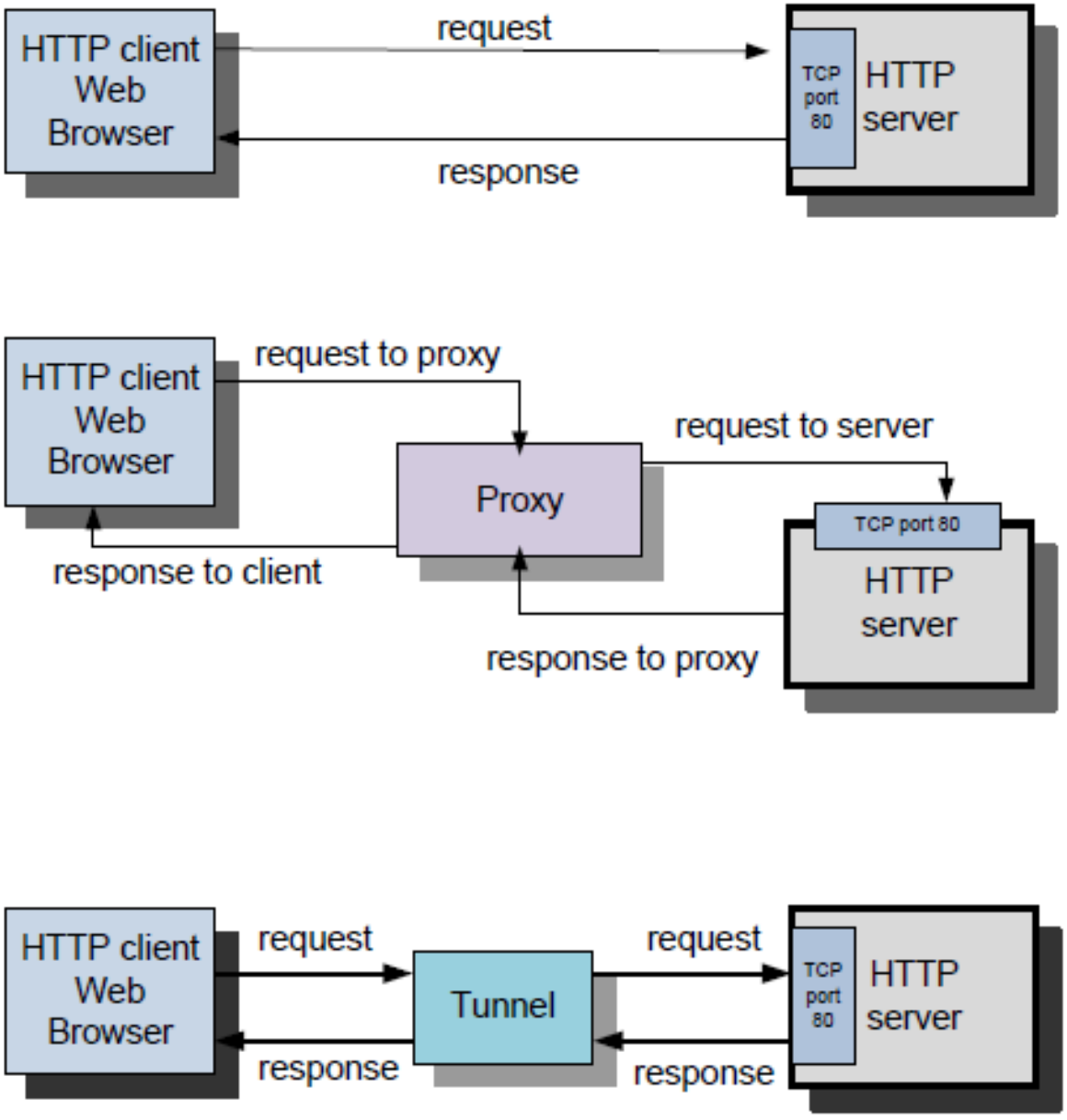
(b)

World Wide Web.

The three-way handshake involves the first three messages exchanged between the client and the server. Once the TCP connection is established the HTTP server takes its time to construct the page to respond the first request; to satisfy the second request, the HTTP server must retrieve an image from the disk.

The response time includes the RTT, the server residence time, and the data transmission time.





A Web client can: (a) communicate directly with the server; (b) communicate through a proxy; (c) use tunneling to cross the network.

USE-CASES