Cloud Architectures

Embedded Interface Design

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Learning Objectives

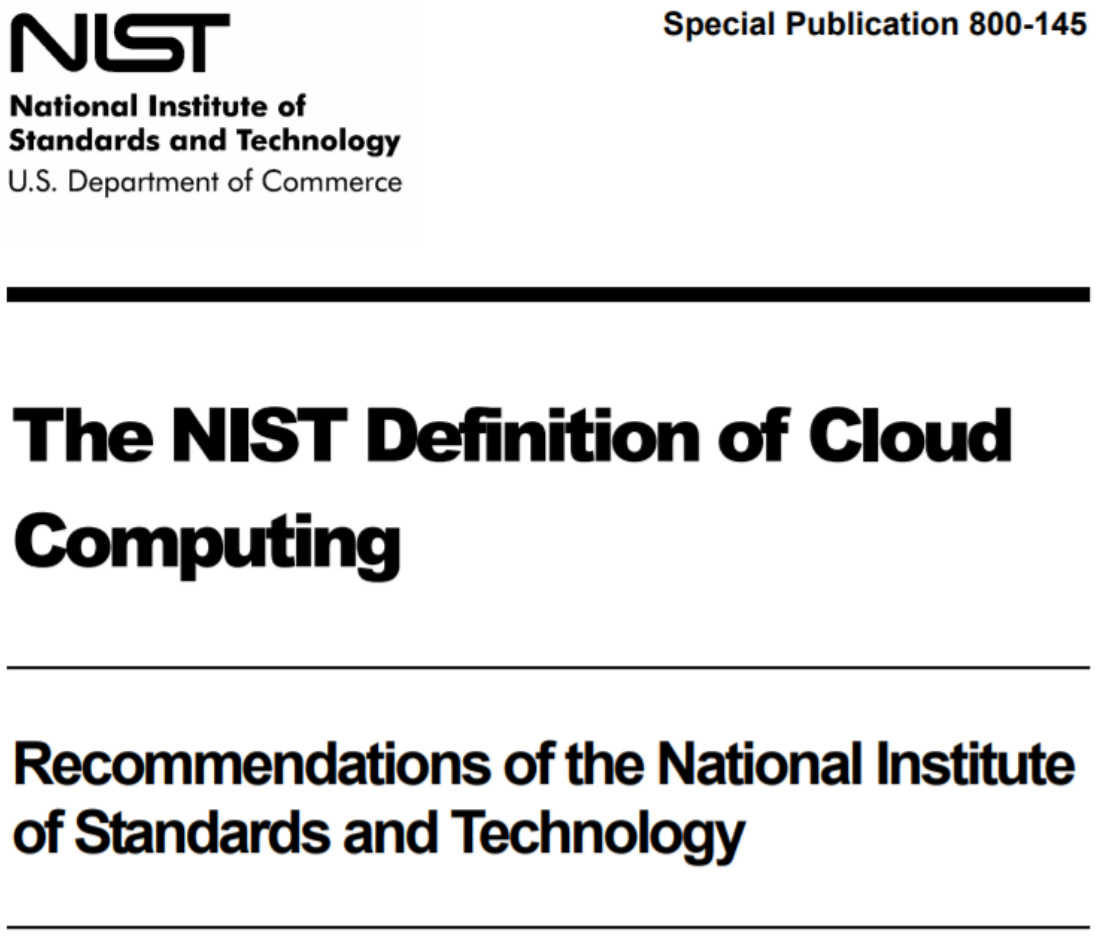
- Students will be able to…
  - Recognize basic cloud architecture definitions
  - Compare and contrast architecture differences

Cloud Architectures for Embedded Devices

- Cloud architecture and design are extremely complex and diverse topics in their own right
- We will specifically look at cloud architectures from the perspective of support for embedded device communications interfaces, IoT support, and rapid system prototyping
- We will not dive into the more complex web and database system design and support than can arise in cloud designs, such as web system load-balancing, multi-tier data stores, etc.

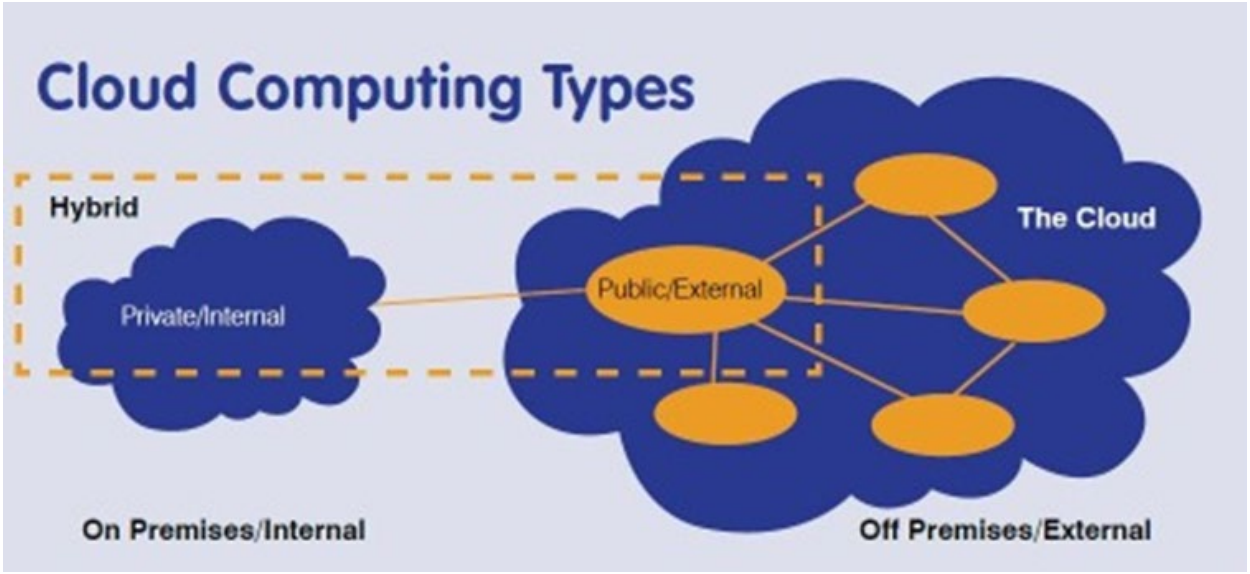
Cloud Definition: NIST 800-145

- "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." [1]
- Essential Characteristics
  - On-demand self-service
  - Broad network access
  - Resource pooling
  - Rapid elasticity
  - Measured service



Cloud Deployment Models

- Private/Community/Public/Hybrid Cloud [1]
- Private: Cloud operated by an organization for it's own use
- Community: Cloud provisioned for use by a group of consumers with shared concerns
- Public: Cloud operated by a third party for open use
- Hybrid: A model combining aspects of public, community, and private clouds
- Image is reference [4]



History of the Cloud

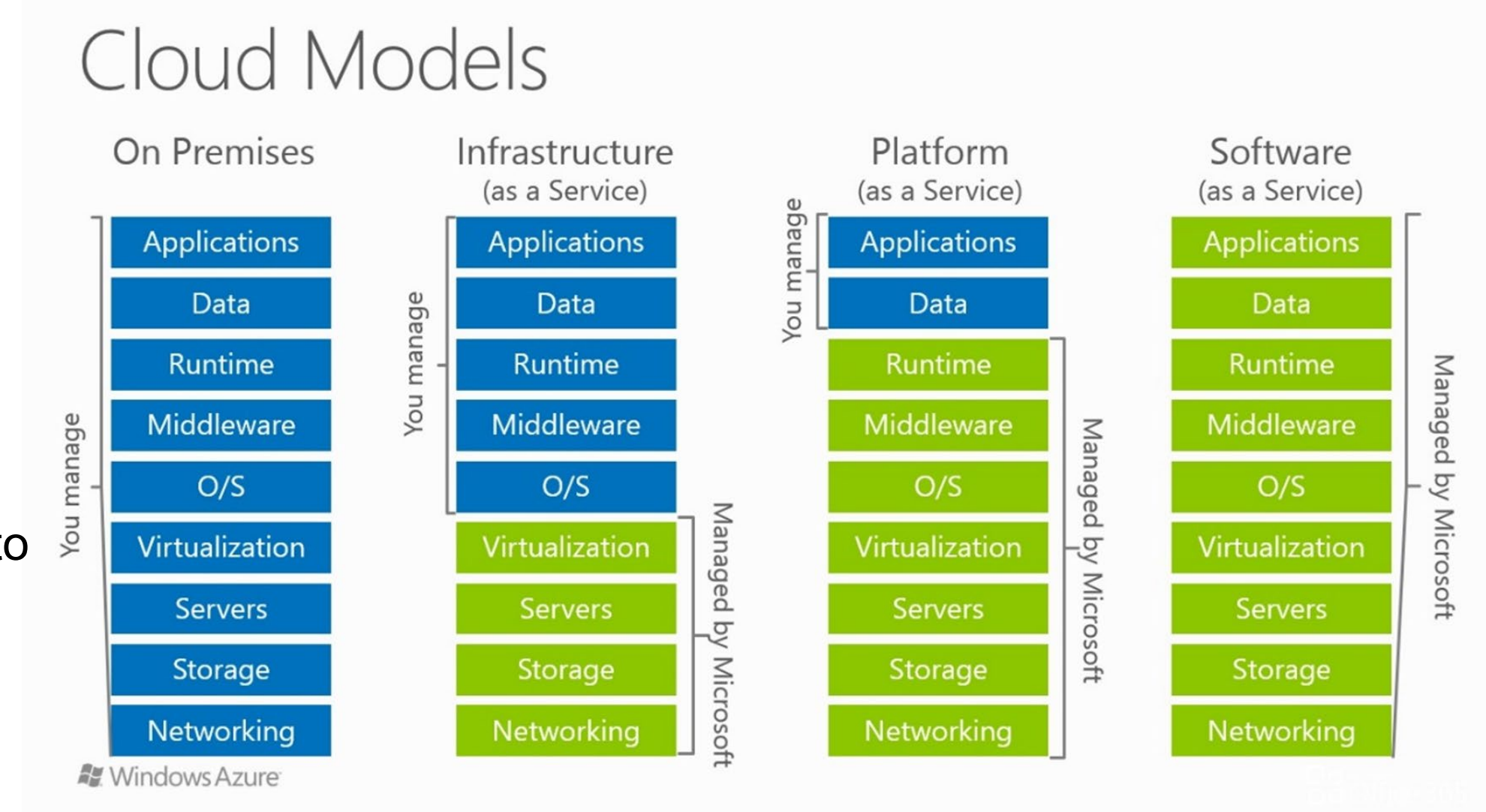
- 1963 – DARPA/MIT – Project MAC – computer to be used by two or more people simultaneously
- 1969 – ARPANET – Internet precursor
- “Intergalactic Computer Network” -> Internet – J.C.R. Licklider
- 1990s – Virtual Computers
- 1997 – Cloud Computing defined
- 1999 – Salesforce
- 2002 – Amazon retail
- 2006 – Amazon Web Services and Google Docs launched
- Reference [8]

Cloud Related Definitions

- Fog Architecture – a distributed infrastructure, where another layer of processing and storage at a system's Edge Devices offloads work from the cloud – an IoT model [2]
- Virtualization
  - "the art and science of making the function of an object or resource simulated or emulated in software identical to that of the corresponding physically realized object" [3]
  - In most cases for the cloud, this refers to virtual machines for running applications

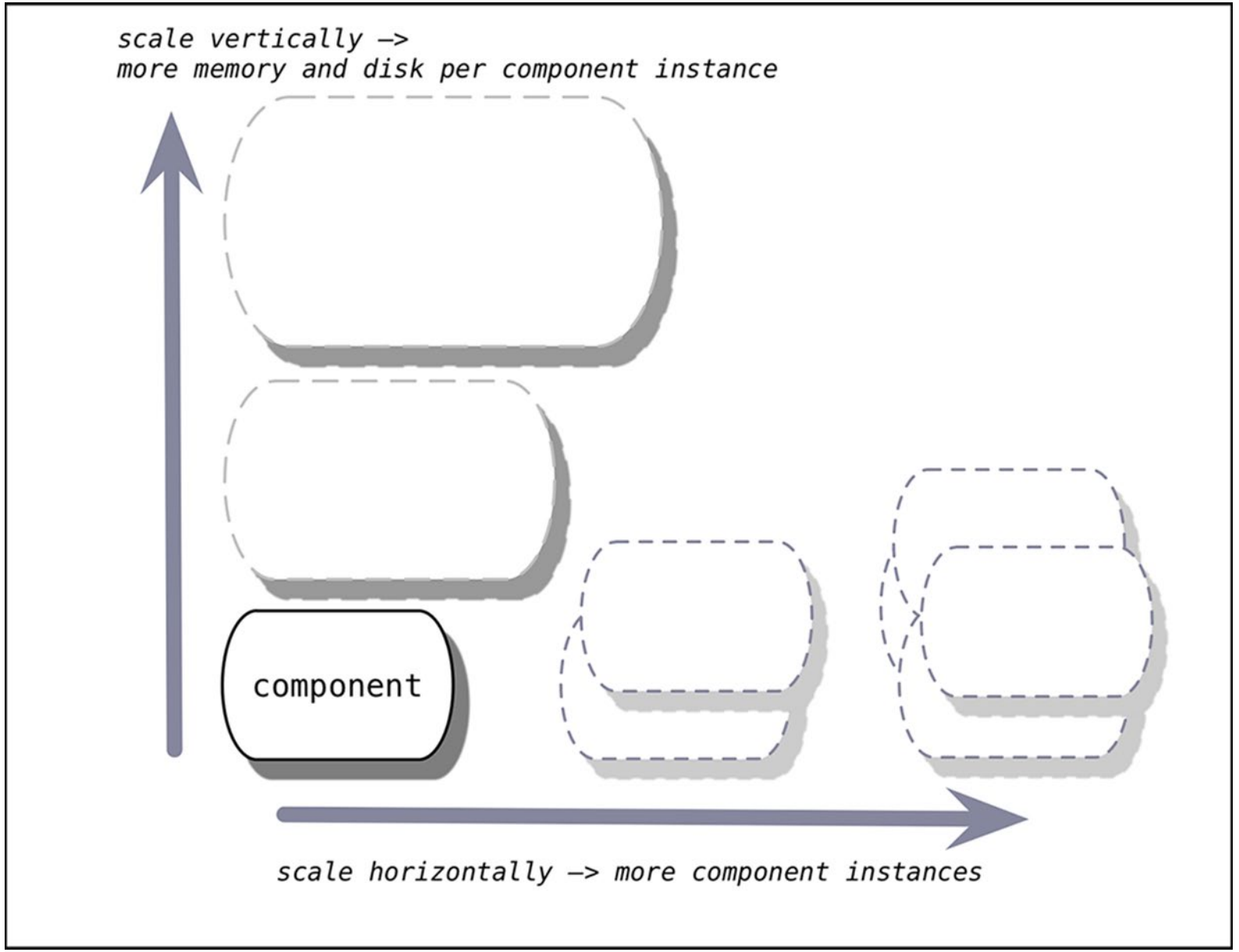
Cloud Service Models

- IaaS, PaaS, Saas -
- What you manage vs. what you pay to have managed…
- Reference [6]



Scalability

- Vertical – Add processing power to existing instance
- Horizontal – Add more instances of processors



Cloud Storage Options

- Immediate vs. Archival Access
- Short Term (Cache) vs. Long Term (Non-volatile)
- File systems for VMs
- RDBMS with queries
- Storage volume demands
- Connectivity
- Performance
- Durability and Availability
- Content Delivery Networks (e.g. Netflix)

Reference [10]

	Amazon Simple Storage Service (Amazon S3)	A service that provides scalable and highly durable object storage in the cloud.
	Amazon Glacier	A service that provides low-cost highly durable archive storage in the cloud.
	Amazon Elastic File System (Amazon EFS)	A service that provides scalable network file storage for Amazon EC2 instances.
	Amazon Elastic Block Store (Amazon EBS)	A service that provides block storage volumes for Amazon EC2 instances.
	Amazon EC2 Instance Storage	Temporary block storage volumes for Amazon EC2 instances.
	AWS Storage Gateway	An on-premises storage appliance that integrates with cloud storage.
	AWS Snowball	A service that transports large amounts of data to and from the cloud.
	Amazon CloudFront	A service that provides a global content delivery network (CDN).

Possible Cloud Services


Compute


Storage


Database


Migration


Networking & Content Delivery


Developer Tools


Management Tools


Media Services


Security, Identity & Compliance


Analytics


Machine Learning


Mobile Services


AR & VR


Application Integration


Customer Engagement


Business Productivity


Desktop & App Streaming


Internet of Things


Game Development

Reference [5]

Cloud Tradeoffs, Advantages, Disadvantages

Tradeoffs

- Public vs. Private (vs. Hybrid) – what do you manage
  - Costs – how do you pay for each part – direct or indirect
- Proprietary vs. Open Source (or mixed model)
- Custom vs. Portable (or mixed)
- Specific technologies – databases, hypervisors (virtual machine monitors), etc.

Advantages

- Cost reduction – reduce capital, manage operating expenses
- Response to demand
- Focus on core business
- Rapid innovation and deployment
- Improved security
- Low energy and infrastructure
- Future proofing business growth

Disadvantages

- Dependence on outside services
- Difficulty in porting an existing infrastructure
- Cheaper paths to stable levels of demand
- Disadvantages often answerable with a hybrid cloud approach

Reference [7]

References

[1] https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf
[2] https://www.westbaseuk.com/news/fog-computing-vs-cloud-computing-whats-the-difference/
[3] https://www.networkworld.com/article/3234795/virtualization/what-is-virtualization-definition-virtual-machine-hypervisor.html
[4] http://cioresearchcenter.com/2011/01/back-to-basics-private-vs-public-cloud/
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