Heterogeneity

Heterogeneity is applied to the network, computer hardware, operating system and implementation of different developers. A key component of the heterogeneous distributed system client-server environment is middleware. Middleware is a set of services that enables application and end-user to interacts with each other across a heterogeneous distributed system. (Singh, 2021)

The Internet allows users to access services and run applications over a heterogeneous assortment of computers and networks. Heterogeneity applies to any or all of the following:

1. Networks
2. PC hardware
3. Programing languages
4. Operating systems

Implementations by totally different developers.

Although the internet consists of the many different types of network, their variations are disguised by the actual fact that every one of the computers connected to them use the internet protocols to speak with each other. (Anon., n.d.)

Programs written by completely different developers cannot communicate with each other unless they use common standards, for example, for network communication and also the illustration of primitive data items and data structures in messages. For this to happen, standards ought to be united and adopted as have the internet protocols. (Bouchrika, n.d.)

The distributed hash table achieves improved load balance, route length, and congestion with low overhead in environments with heterogeneous node capacities, such as bandwidth or processing speed. Addressing heterogeneity in reliability, we show that randomization in node selection strategies typically reduces failure rates - a property that permits better understanding of subtle properties of existing systems, as well as the design of new systems. Finally, we study how to improve stability in the Internet's interdomain routing protocol, while carefully managing tradeoffs with network operators' preferred routes. These results show how both performance and reliability can be improved in heterogeneous environments. (Godfrey, 2009)

# Exploiting Heterogeneity in Parallel and Distributed Systems (Epema, 2009)

## Hardware

Different hardware characteristics:

* Processor speeds and types.
* Network bandwidth / asymmetric ADSL connections.

**Problem:** select suitable/optimal resources

## Software

* Different software characteristics:
  + Operating systems
  + Compiler versions
  + Libraries
  + Input files
* System configuration
* Problem: correct installation / resource selection

## Management

* Systems management / ownership
  + Authorization and access
  + Usage rules (times of day, limits to sizes of jobs, priority to certain users)
  + System availability
  + Level of system management
* Problem: resource description and selection / translation of requirements

## Roles

* Different roles played by different machines
  + Clients versus servers
  + Peers, super peers, trackers in p2p networks
  + Social roles in p2p systems
* Problem: consider different roles.

# Bibliography

Anon., n.d. *padakuu.* [Online]   
Available at: https://padakuu.com/article/221-heterogeneity  
[Accessed 19 01 2022].

Bouchrika, I., n.d. *ejb tutorial.* [Online]   
Available at: https://www.ejbtutorial.com/distributed-systems/challenges-for-a-distributed-system  
[Accessed 19 01 2022].

Epema, D. H., 2009. *Cloud Front.* [Online]   
Available at: https://d1rkab7tlqy5f1.cloudfront.net/EWI/Over%20de%20faculteit/Afdelingen/Software%20Technology/Distributed%20Systems/People/Dick%20Epema/heteropar2009-epema.pdf  
[Accessed 20 January 2022].

Godfrey, P. B., 2009. *Designing Distributed Systems for Heterogeneity.* [Online]   
Available at: https://www2.eecs.berkeley.edu/Pubs/TechRpts/2009/EECS-2009-82.html  
[Accessed 20 January 2022].

Singh, C. K., 2021. *Design Issues of Distributed System.* [Online]   
Available at: https://www.geeksforgeeks.org/design-issues-of-distributed-system/  
[Accessed 20 January 2022].