University of Dublin
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CS7CS3: Software Architecture – Technical

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Software Architecture

What is it?

- Defines the basic components and important concepts of a system
- Describes the relationships between components/concepts

Different Views:

- Functional Architecture
  - *view of software components*
- Technical Architecture
  - *view of where software components reside*
  - *strong focus on **quality attributes** (e.g., latency, security,*

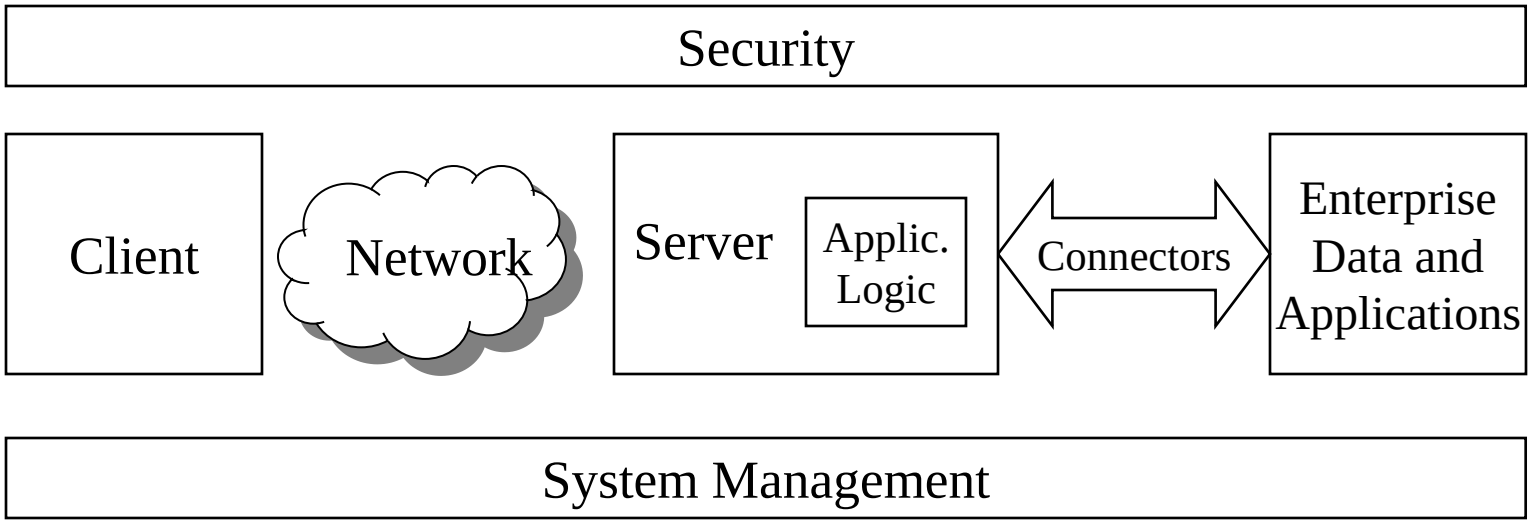
Technical Architecture

Possibilities for physical placement of software:

- Single machine
- Distributed
  - *Client-server*
  - *Peer-to-peer*
  - *Internet of Things*
  - *Edge network*
  - *Ad hoc*
  - *….*

Trade-offs for non-functional quality requirements

Architecture Building Blocks



Source: “An Approach to Designing e-Business Solutions”, SG24-5949-00
available from http://www.redbooks.ibm.com

Security – Decision Points

Encryption

- Do transactions need to be encrypted?
- Level of encryption? (e.g., 40-bit encryption in US)

User Identification

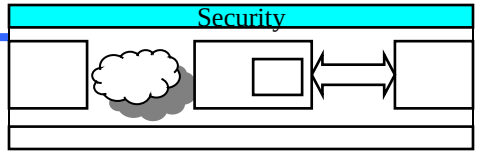
- uid/pw, cookies, certificates, application-level?
- Existing customer database that should be used to identify online visitors?

Access to data

- Do you need to restrict access to parts of the site?
- What **privacy rules** should be applied to information provided by users

What are the legal requirements and company policies for auditing content, changes and transactions? GDPR?

Does the company already have a secure demilitarised zone into which the Web server could be placed?



System Management – Decision Points

Do you have the infrastructure to install and run you own server?

What are the **response time** targets?

***Availability*:**

- What hours should the service be available?
- Is it acceptable to have any scheduled downtime for maintenance?
- How important is it that the service be never interrupted, even for unscheduled component failures?
- If interruptions do occur, what should be the target time for resuming service?

How should partial or total service failures be monitored and handled?

Do you need a recovery plan, or will it be covered by existing processes?

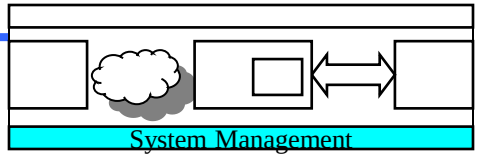
Tracking/Documenting:

How should the architecture support the process of problem reporting, tracking and fixing?

What statistics do you need to keep about the site, and how will they be analysed?

What instrumentation should be included in the design to measure performance, response times and availability?

Should the architecture include a repository for statistical data?



Client – Decision Points

About the user:

Who is the customer? (Internet or Intranet) – affects browser choice

What is the level of the user's skill?

What languages should the site support?

What are the user's usage patterns? (search or browse)

Mobile device support?

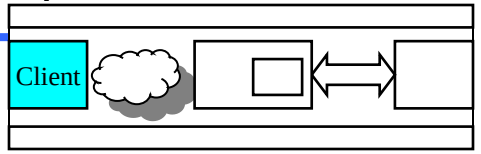
About the application:

How will the application maintain state?

Is there a need to distribute application code, and if so, how will it be done?

How will the choice of client affect end-to-end response? (HTML, JavaScript, AJAX, JQuery, VBScript?)

Is the browser the only user interface? (e.g., mail?)



Network – Decision Points

Will my solution involve the internet?

What protocols will I use?

HTTP? HTTPS? FTP? RMI? Messaging? etc

What about data, object and application placement?

projected transaction volumes, amount of data, interaction?

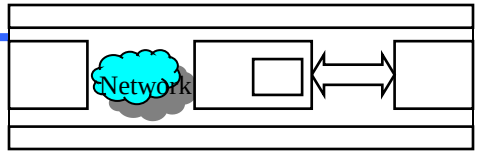
What security functions are required/provided by chosen protocol?

level of encryption will affect this, and also performance!

Will existing network function as required?

expansion needed?

How does the network affect end-to-end response time?



Server – Decision Points

Functional considerations:

Are mail or conferencing facilities needed?

Are there workflow requirements?

Are indexing, searching or other site navigation aids required?

Technical considerations:

Single server or multiple servers? Peer-to-Peer? Edge Network? IoT?

Geographic location for servers?

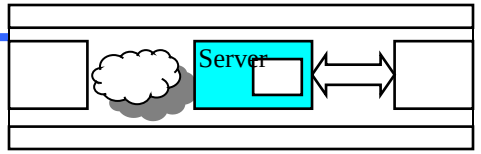
End-user client to server, or server to server required also?

Do client options affect the design of the server?

What security functions are required on the server?

How can impact of server on end-to-end response time be estimated?

some benchmark numbers may be available but not straightforward!



Application Logic – Decision Points

Is this a logical two-, three- or n-tier solution?

Will object technology development, traditional programming development or integrated packages be used?

Application control (for end-user print/save) required?

Is normal HTML adequate, or need an enhanced UI?

Is client-side scripting needed? At what level?

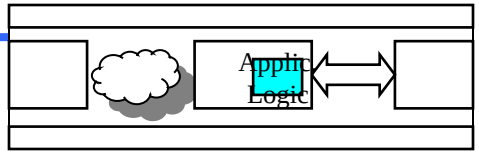
check all possible browsers?

Will site use proprietary scripts/tags/plug-ins?

Will site use client-side executables? What are their connectivity requirements?

How will application be split between client-side and server-side logic? *affects communications for validation etc/performance?*

Additional access security required?



Connectors – Decision Points

What enterprise systems, applications and data does e-business application need to access?

How should data be transferred between different systems?

How current does the information have to be? *Use caches?*

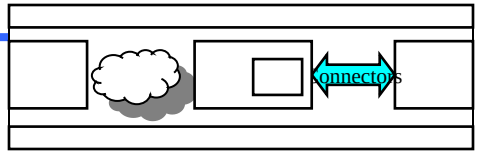
Is synchronous or asynchronous access required? *Off-line OK?*

Is access to different operating systems, network protocols, application environments required? *which connector? CICS? MQSeries? RPC?*

Is a new user interface required? If so, what kind?

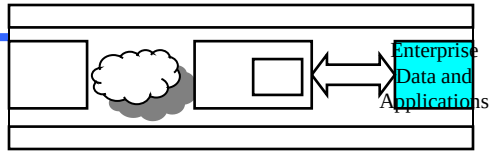
Are additional security policies required?

Can scalability and performance requirements be predicted?



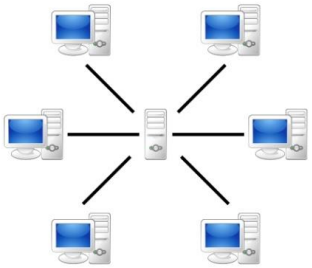
Enterprise Data and Applications – Decision Points

- Do service hours of enterprise data repository match e-business app targets?
- How will access authorisation rules for database map to e-business user identification?
- Is e-business application using the corporate data for reference? (i.e., read only)
- Is the data in a format easily accessed by distributed systems?
- If additional code is needed to gain access to data, how will this be developed?
- If access is to relational databases, can the SQL be structured to minimise network traffic?
- What are the commit and rollback requirements of the application?
- Is there a need for caching?

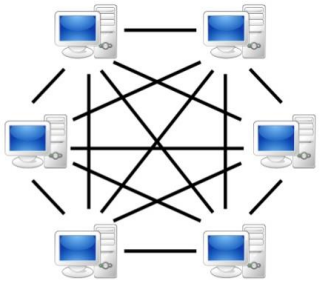


Ultimately, your technical architecture choices will involve a trade-off between all the requirements

Example – Architectural Tradeoffs between P2P and Client-Service Architectures



Server-based



P2P-network

- Clients request services from a server
- Very well-known model

However:

- Scalability possible issue
- Single point of failure
- Management required
- Potential for un-used resources

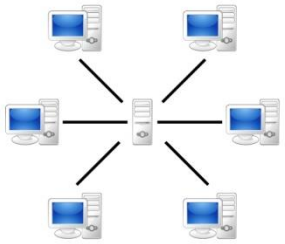
- Every node participates as both client and server
- Very scalable *(need have only part of whole system on each node)*
- No central point of failure

However:

- Decentralised coordination (state consistency, etc)
- All nodes not equal (performance issues)

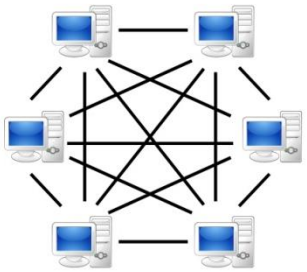
Infrastructure Availability Tradeoff: P2P and Client-Service Architectures

Application



Server-based

- No existing infrastructure
  - e.g., disaster area
- Application is ad hoc



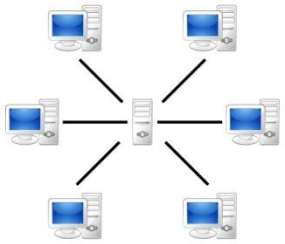
P2P-network

Scalability Tradeoff: P2P and Client-Service Architectures

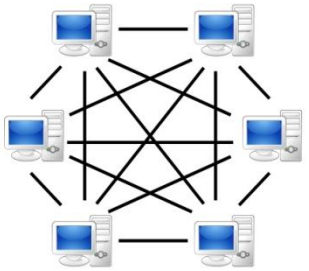
Application

Too hard to manage DHT

Dynamic increases in load, processing, capacity?



Server-based

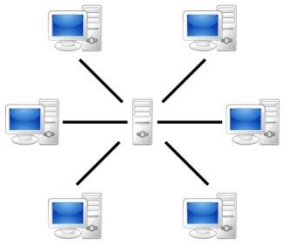


P2P-network

- Dynamic increases in system load?
- More processing, storage capacity required?
- Too hard to manage a distributed hash table (DHT)?

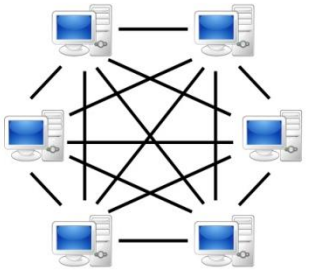
Robustness/Reliability Tradeoff: P2P and Client-Service Architectures

Application



Server-based

- Expect high availability in server-based architectures
- P2P generally not expected to be robust, though could be improved (though at the expense of scalability?)



P2P-network

Performance Tradeoff: P2P and Client-Service Architectures

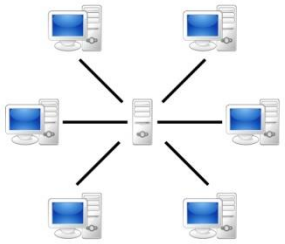
Application

DB queries?
No cooperating peers

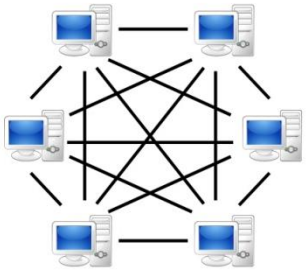
?

Regular (similar) computers, with parallel tasks

?



Server-based



P2P-network

- Performance of P2P system depends on many factors like:

- task type: can it be divided into independent, parallel subtasks? Centralised DB vs DHT?

- lack of peer cooperation

Energy Consumption Tradeoff: P2P and Client-Service Architectures

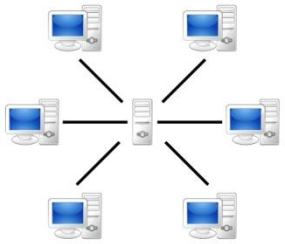
Application

Geographic spread
High energy task

?

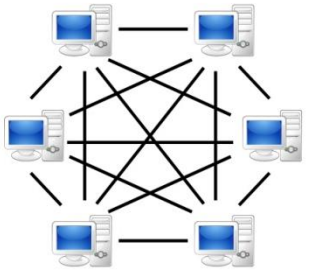
Energy-aware protocols ?
Nodes already in use?

?



Server-based

- Performance of P2P system depends on many factors like task type: whether the nodes are up regardless of task; energy consumption; geographic spread.

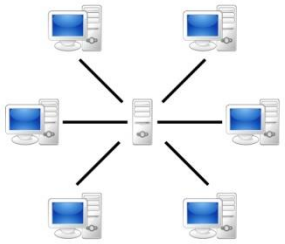


P2P-network

Cost Tradeoff: P2P and Client-Service Architectures

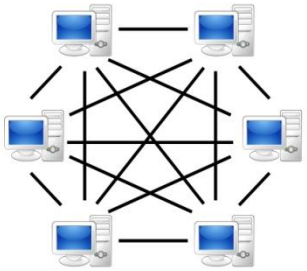
Application

Cost is a big issue



Server-based

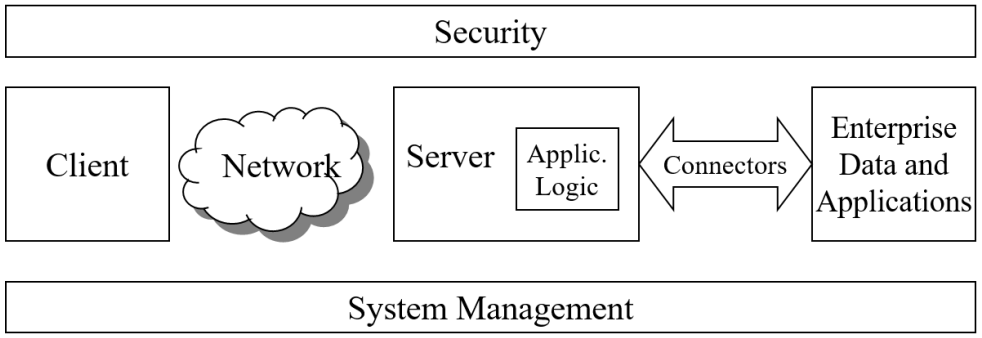
- Is capital or operative cost an issue?
- is the cost of a highly available cloud solution prohibitive?



P2P-network

Again, and in conclusion

Ultimately, your technical architecture choices will involve a trade-off between all the requirements



You will need to clearly indicate the technical choices made for each architectural element. This includes technologies you plan to use plus how all non-functional requirements are met.