

I58258 Web Development

Introduction to Web Applications

Computer Science and Information Technology
School of Mathematical & Computational Sciences
Massey University
(AKLI, DISD & MTUI)

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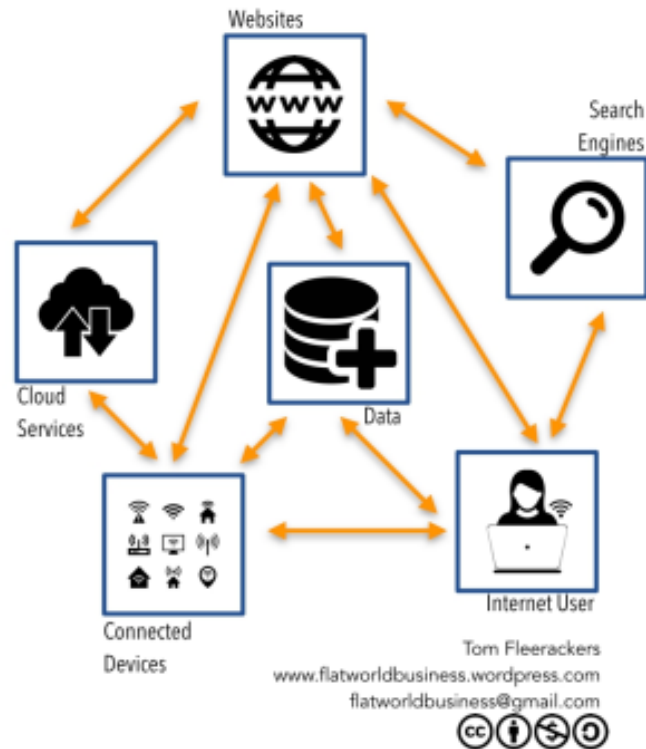
Learning Objectives

- At the end of this topic, you should be able to:
 1. *Describe what web applications do*
 2. *Describe the evolution of the Internet and the World Wide Web*
 3. *Explain important Internet and Web technologies*
 4. *Describe Web application architectures*
 5. *Introduce the concepts of the Web 2.0, 3.0 and AJAX*

Section I: The WWW

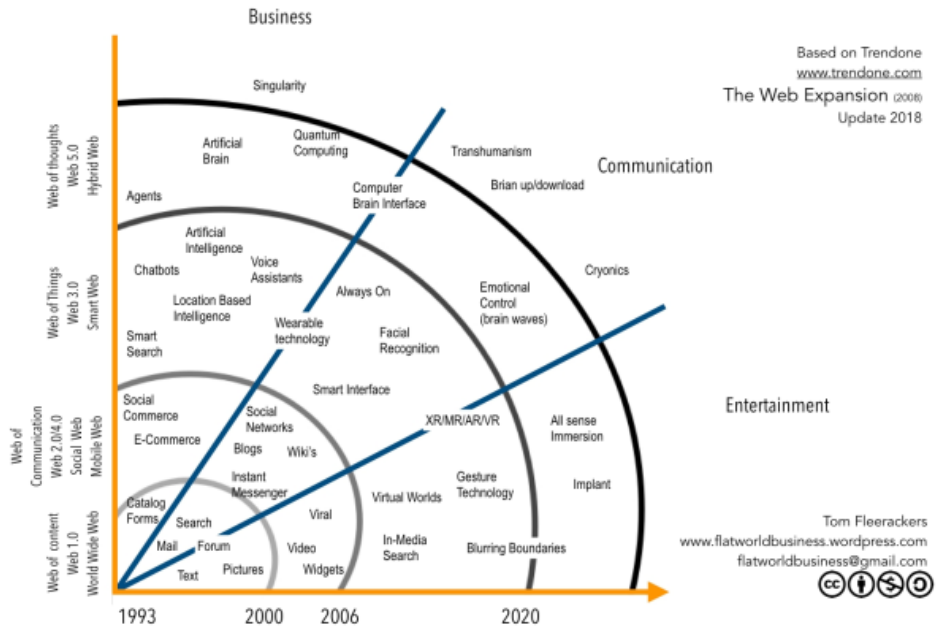
- An introduction to the World Wide Web (WWW or W3)

The Goals of the WWW



Towards Web 3.0, the semantic web

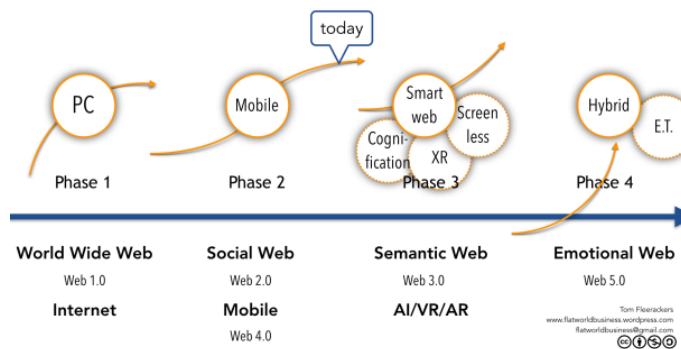
(Blog Post by Tom Fleerackers and Marleen Meyvis)



Towards Web 5.0, the smartweb

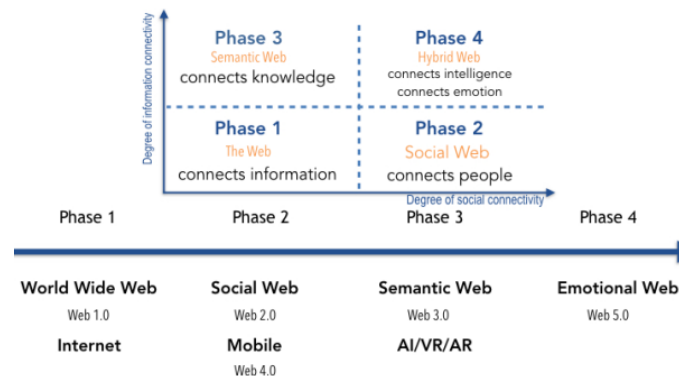
Where We Are Now

- Web based companies like Facebook and Google are as famous as Coke and Virgin
- We expect all the organisations that we deal with to have a web presence
- We expect to be able to manage our money, book travel and purchase goods and services without having to step away from the computer.



**Just passed Web 2.0 and 4.0
in the evolution of the Web**

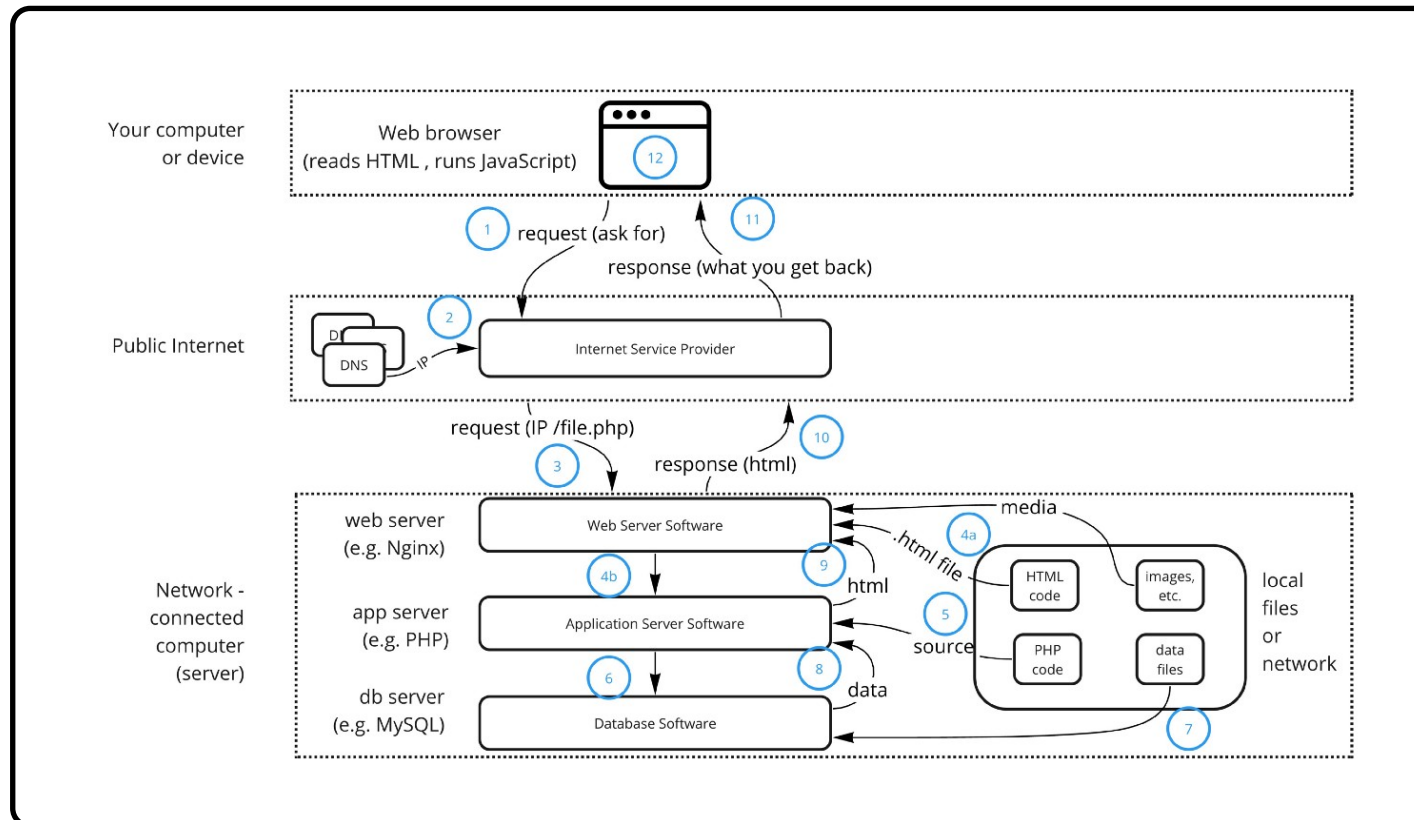
(See also the Blog Post by Tom



**Two-dimensional model for the
evolution of the Web**

Fleerackers and Marleen Meyvis)

What the Web Application Does



[Mike Sparr (2018), [How Web Applications Work](#), medium.com]

Click link for walkthrough of this diagram:

Here is how Mike Sparr explains how Web applications work by using the diagram on this slide:

1. Your device or computer is connected to the Internet and your browser requests a URL (yahoo.com/finance.php)
2. Your device connects to the public Internet via your ISP (broadband or cellular provider) and tries to find the address for yahoo.com via DNS lookup which is like a phone book for network addresses to computers connected to the Internet. It allows a look up by [domain] name and returns an IP address like 55.55.55.55, just like your name might return your phone number in a phone book. This is the network address of the computer that is hosting that domain.
3. Your request is transmitted through the Internet to the IP address you found similar to typing that number in your phone and placing a call.
4. The computer connected to that IP address would have web server software running on it that will go fetch the requested file, and send it back. (a) if just a .html file, the server finds it on the computer and sends it back. (b) if a .php file, the web server knows to hand off the request to the application server that will process the PHP code.
5. The application server receives an HTTP Request from the web server, finds the file with the source code (programming instructions) for that web address (i.e. finance.php), and executes your PHP program.
6. The program references a connection to a database server (just another program run on the computer) and sends it a “query” to request data stored and organized by the database server.
7. The database server fetches the files requested from the query.
8. The database server sends back the requested data to the application server.
9. The application server combines this data with any other data your program instructs it to add, and sends it all back to the web server as an HTTP Response. Typically you just output HTML-formatted text but your program can inject data into it as it loops, etc.
10. The web server sends back the HTML text to the requesting connection.
11. The data is transmitted over the Internet back to your computer or device and the connection ends.
12. Your device browser reads the HTML code (that was generated) and displays it on the screen.

This summarises how typical Web applications work.

E-Everything — *The Internet and the World Wide Web*

- Web applications rely on both the Internet and the World Wide Web
 - They are not the same thing -The Internet predates the web by more than 10 years
- In the late 1970s the US Advanced Research Projects Agency (ARPA) built the 'ARPAnet':
 - Originally linked a small number of research sites
 - Same core technologies as the much bigger Internet that followed

The World Wide Web (WWW)

- The World Wide Web (WWW or W3) dates from the 1990s.
- A hypertext based collection of multimedia information accessible via the Internet.
- The traffic on the information highway.



Information Highway

Evolution of the Web

- The web began largely as an academic tool.
 - *Its main aim was to assist research.*
- It soon became popular for leisure applications.
- It has since become a key element in business, not only for .COMs but as part of the IT strategy of a wide range of organisations.



World Wide Web

Timeline

- **1990:** Invented by Tim Berners Lee at CERN (European Organisation for Nuclear research):
 - *A distributed hypertext system for managing information at CERN (Based on previous hypertext research)*
- **1991-3:** web servers begin to come on line outside of CERN. WWW technology made 'free' by CERN
- **1993:** First publicly available graphical browser - NCSA Mosaic
- *Commercial and other browsers followed (Navigator, Explorer, Opera, Safari, Firefox, Chrome etc.)*

Internet Technologies

- There are some core technologies that enable the Internet to work
 - *TCP/IP*
 - *IP Addresses*
 - *The Domain Name System (DNS)*

(End: Section I)

Section 2: The Internet

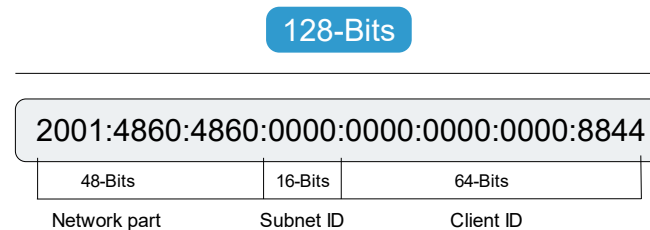
- An introduction to concepts of the Internet

TCP/IP

- The Internet uses a communications protocol known as TCP/IP:
 - *Transmission Control Protocol / Internet Protocol.*
- Actually a whole set of related protocols and tools:
 - *Related protocols include SMTP (Simple Mail Transfer Protocol)*
 - *Related tools include FTP (File Transfer Protocol)*

IP Addresses

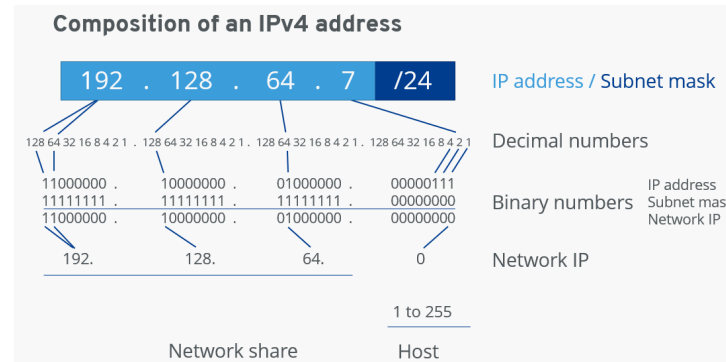
- Computers are identified by their 'IP address'.
- Hardware devices known as 'routers' glue all the different networks together.



Example IPv6 Address Format

- Every machine on the internet has a unique IP address:
 - *IPv4 addresses are 32 bit binary numbers (billions of combinations).*
 - *IPv6 addresses are 128 bit binary numbers (3.4×10^{38} , 340 trillion trillion trillions)*
- IPv4 addresses are expressed as four sets of dotted decimal numbers:
 - *The format is nnn.nnn.nnn.nnn*
 - *Each of these numbers falls in the range 0 – 255.*
 - *e.g. 127.0.0.1*

- Given an IP address, one machine can connect to another as if they were on the same physical network.
- Some machines have fixed IP addresses. Others are temporarily allocated an IP address from a pool when they connect.



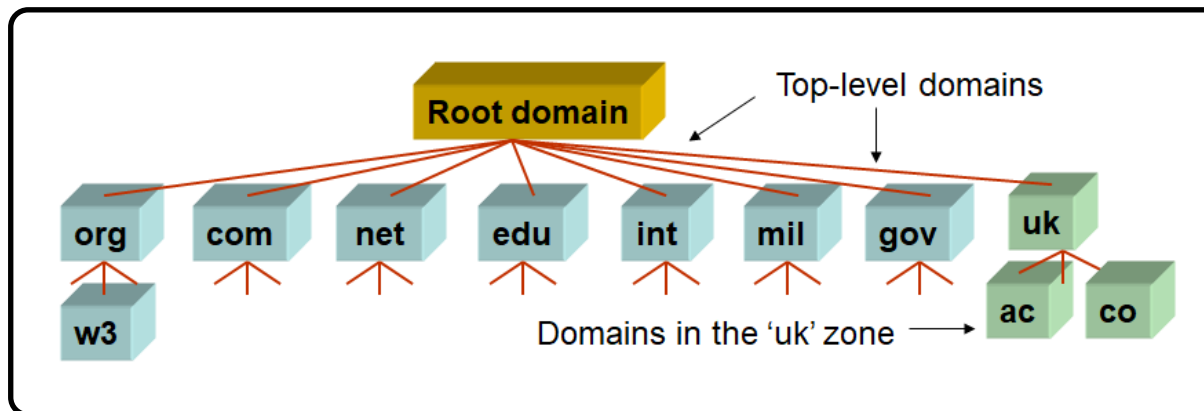
Example IPv4 Address Format

Domain Names

- Most **Web site hosts** use *domain names* rather than actual *IP addresses*.
- The **Domain Name System** (DNS) enables domain names to be converted into the correct IP address
 - ‘resolver’ programs query name servers for IP addresses.

DNS Zones

- The DNS consists of a number of dedicated servers (a distributed database) that maintain naming information for different 'zones'.
- These zones relate to type of site or country of origin
 - *Several name servers may be involved in resolving a single name request.*
- A zone is a set of related domain names, e.g .com, .edu, etc. organised in a tree.



Advantages of Domain Names

- Domain names are better than just using IP addresses because:
 - *Domain names are easier to remember.*
 - *Names reflect the identity of the owner.*
 - *The mapping between a domain name and an IP address can change, so the same name can migrate between different host systems.*
- They are also important for email.
 - *Email addresses use domain names.*
 - e.g. web-human@w3.org

(End: Section 2)

Section 3: WWW Technologies

- An introduction to the core technologies of the WWW

Important World Wide Web Technologies

- HTTP (HyperText Transfer Protocol)
- HTML (HyperText Markup Language)
- URIs, URLs and URNs:
 - *URI (uniform resource identifier)*
 - *URL (uniform resource locator)*
 - *URN (uniform resource name)*

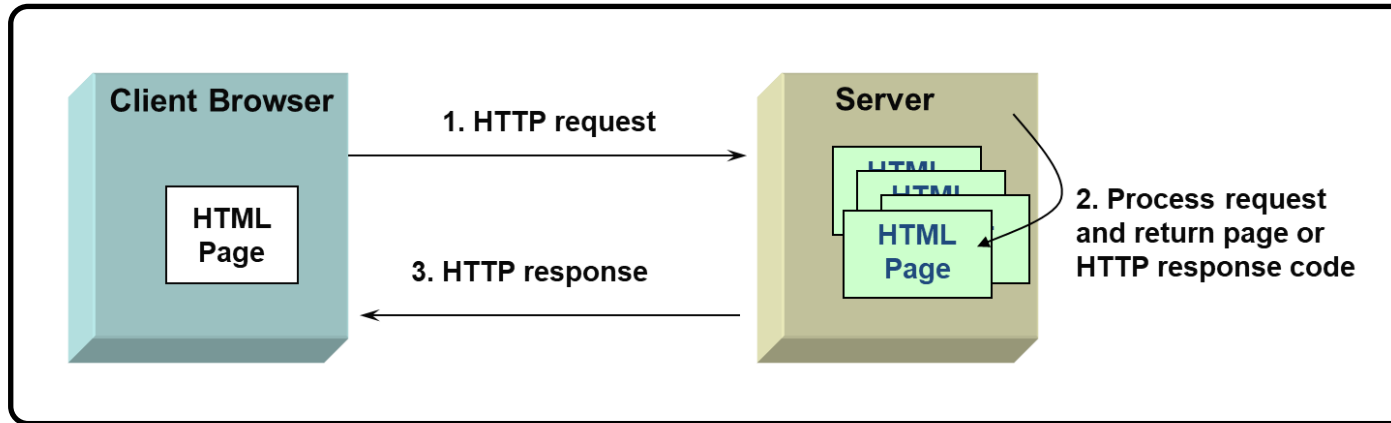
HyperText Transfer Protocol (HTTP)

- HTTP is a 'request-response' protocol:
 - *Clients (usually browser software) send a request to a web server*
- The server handles the request and provides a response, usually in the form of an HTML page

HTTP Request Types

- HTTP Requests can be:
 - *GET, POST, HEAD, PUT, DELETE, CONNECT, OPTIONS or TRACE*
- Usually GET or POST:
 - *A GET request is used to retrieve information from the server (often contains a search query or other parameter data)*
 - *A POST request is used to send data to the server (typically from an HTML form)*

Web Clients and Servers



- Web **clients** (browsers) send HTTP requests and Web **servers** send HTTP responses
 - *Thus, Web server provides HTML pages to the Web client*

HTML

- The information on the web is mainly in the form of HTML (HyperText Markup Language) pages.
- HTML pages are text documents that contain special mark-up tags telling the browser what type of information they contain
- It is up to the browser to format the page and manage its content
 - *The same page can look different in different browsers*
- As well as text, these pages can contain images, sound, animation and other programs (e.g. Flash, Real Player, Adobe Acrobat etc.)
- Browsers can use 'plugins' to handle these special types of content
- One aim of HTML5 is to reduce the need for these

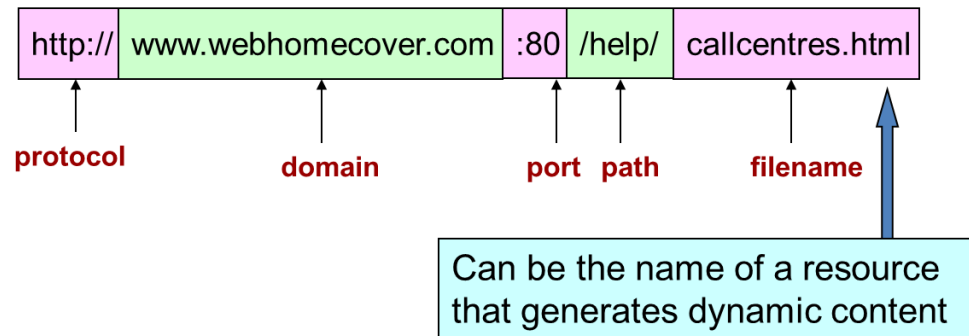
```
<!DOCTYPE html>
<html>
  <head>
    <title>My Page</title>
  </head>
  <body>
    ...
  </body>
```

</html>

URLs

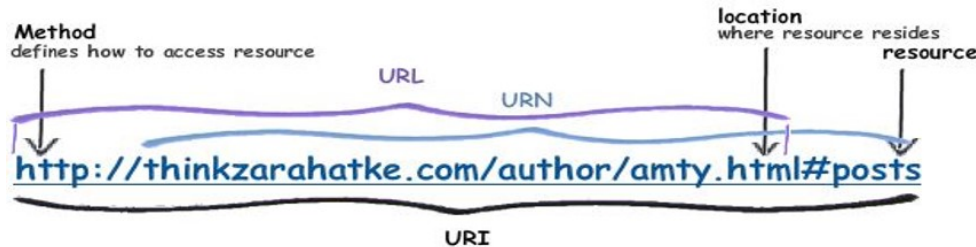
- A URL is the complete location of an Internet resource, comprising:

- The *protocol of the request* (usually <http://>)
 - The *server's domain name or IP address*
 - The *port number* (*http is usually 80, https 443*)
 - The *subdirectory path* (if applicable)
 - The *name of the resource* (though there may be a default)
- Failed requests have specific HTTP responses
 - e.g. 404 – file not found



Example URL

URL vs URI vs URN



Example URI

- A URL is a specific kind of URI (Uniform Resource Identifier) that identifies a web resource that can be downloaded
- Another type of URI is a URN (Uniform Resource Name), which looks like a URL but does not necessarily relate to a web resource.
 - *Only used to provide a globally unique name for something*

(End: Section 3)

Section 4: Web Applications in Modern Business Organisations

- An introduction to the Web application infrastructure in modern business organisations

Intranets

- As well as having a public presence on the internet, many companies maintain a private *'intranet'* behind a security *'firewall'*:
 - *Pages that are only available inside the company*
 - *Low cost of ownership by using the standard technologies of the internet*
 - *'Paperless' internal communication*
 - *Information from corporate databases in accessible formats*

Extranets

- An extranet falls somewhere between the internet and an organisation's intranet
 - *Only selected outsiders, such as customers, suppliers or trading partners, are allowed access*
- Extranets can range from highly secure business to business (B2B) systems to self-registration systems
 - *Can be used, for example, to allow customers of courier companies to track their deliveries*

Portals

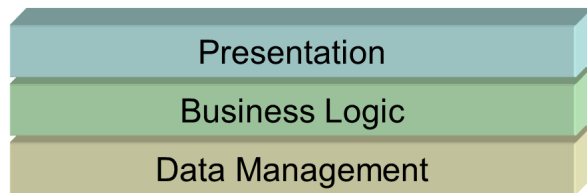
- Gateways into other applications
 - A collection of 'portlets'
 - Personalised / customisable
 - Used in early versions of the mobile internet (e.g. Vodafone Live!)
 - See My Yahoo!, DigitalNZ etc.
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(End: Section 4)

Section 5: Design of Web Applications

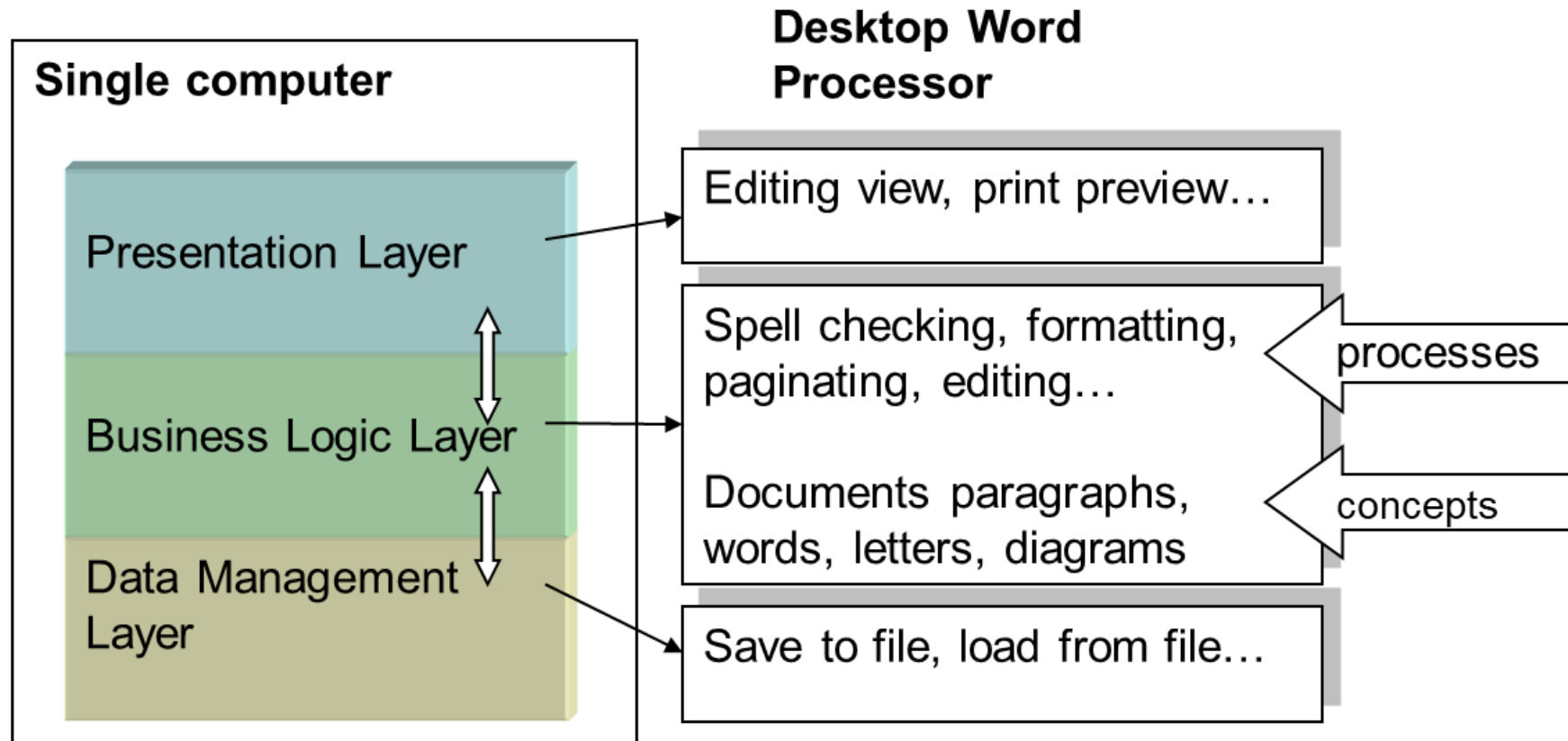
Layers in Information Systems

- Conceptual layering of system components
- May or may not be deployed on separate physical nodes



IS Layers

Example: *Layers in a Word Processing System*



Layered Architecture of a Word Processing System

AJAX

- Asynchronous JavaScript and XML (AJAX) - *in modern Web development XML may be replaced with a different technology.*
- JavaScript is a programming language that can run inside a browser
- Rich user experience
- With AJAX, we can update parts of the page dynamically by connecting to the server without replacing the current page

Web 2.0

- First Web 2.0 Conference 2004
- The web as a software platform
 - *Software above the level of a single device*
- Service oriented architectures
 - *XML, mashups, RSS*
- User and contributor communities
- Wikis, blogs, reviews

Web 3.0

- Decentralized
 - The foundation for P2P (peer-to-peer) communication, payments, services, and marketplaces
 - Blockchain technology
 - Cryptocurrency
-

(End: Section 5)

Section 6: Topic Summary

Summary

- Principal features, technologies and uses of web applications
 - The Internet and the World Wide Web
 - Distributed architectures that web applications use
 - Some special types of web application.
 - Web 2.0, 3.0 and AJAX
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