

# COMP 2410 – Networked Information Systems

## 1. Network Infrastructure

**Roger Clarke**

Xamax Consultancy, Canberra  
Visiting Professor, A.N.U. and U.N.S.W.

<http://www.rogerclarke.com/II/NIS2410.html#L1>  
[{.ppt, .pdf}](http://www.rogerclarke.com/II/NIS2410-1)

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# Networked Information Systems This Series of Six Lectures

## Network Infrastructure and Architecture

### 1. **Network Infrastructure**

Networks, Devices, Services, Uses & Abuses

### 2. The Architectures of Networked Applications

## Information Assurance and Security

### 3. Security of Information and IT

### 4. Malware and Other Attacks

### 5. Data Protection and Privacy

### 6. Key Security Safeguards

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## 1. Networks Wired vs. Unwired

- Twisted-Pair
- Copper Cable
- Coaxial Cable
- Fibre-Optic Cable
- Wifi
- Cellular
- Fixed Wireless
- Satellite

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## National Broadband Network (NBN)

**FTTP / FTTN**  
for 'urban'  
93% of 24m

**Fixed Wireless**  
for 'rural'

**Satellite**  
for 'remote'



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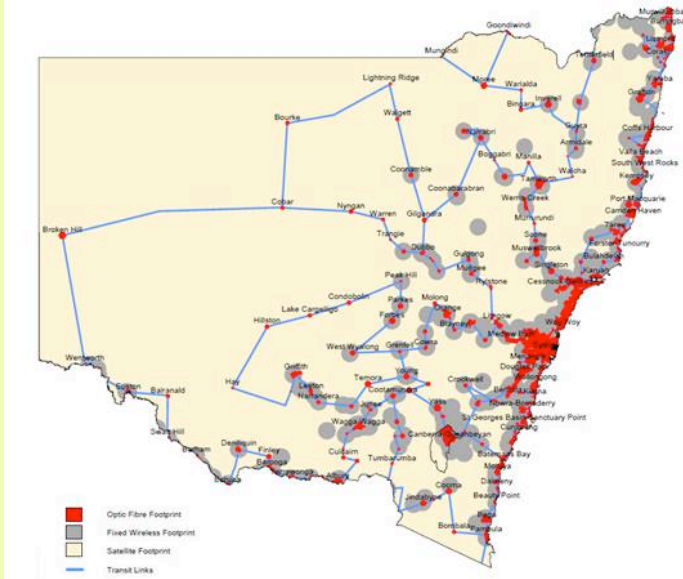
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## NBN in NSW

FTTP / FTTN  
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<http://www.itnews.com.au/gallery/photos-nbn-coverage-maps-221455/page2>

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## Wireless Networks

- **Wide Area Networks – Cellular** (50m to 10km cell-radius, with increasing data capacity per user, particularly from 3G onwards)
  - 1G – Analogue Cellular, e.g. AMPS, TACS (1987-2000)
  - 2G – Digital Cellular, e.g. GSM, CDMA (1992-2016/17)
  - 3G – GSM/GPRS/EDGE, CDMA2000, UMTS/HSPA (1998-)
  - 4G – LTE, deployment nearing completion 2015-17 (2008-)

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- **Local Area Networks – 'WiFi'** (10-100 m radius), (1999-) primarily IEEE 802.11x, where x=a,b,g,n, ac, etc. – vs. LTE?

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## Wireless Networks

- **Fixed-Wireless/Line-of-Sight** – 802.16 (WiMAX) (2008-) TD-LTE/LTE-TDD (2012-) (3-10 km per cell, high-capacity per user, local monopoly?, trees!)
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- **Personal Area Networks** (1-10 metres) – Bluetooth? Infra-red?
- **Contactless Cards / RFID Tags / NFC Chips** (1-10cm radius)

## Different Interpretations of 'Mobile'

- **Variable-Location**, rather than Fixed  
Portable PC as well as Handhelds  
Doesn't necessarily require Wireless Comms
- **Device-in-Motion**  
Use within a Room, Building, Campus, Car, Train, ...
  - Generally, Wireless Comms are area-limited
  - How to achieve 'handoff' between cells  
and sustain the conversation / session?

## 2. Network-Connected Devices

'Any device that provides users with the capacity to participate in Transactions with Adjacent and Remote devices by Wireless Means'

- **Nomadic / Untethered Portables**
- **Mobiles / Smartphones**
- **Handheld Computing Devices**  
PDAs, games machines, music-players,  
'converged' / multi-function devices,  
**Tablets esp. iPad but now many followers**

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- **Processing Capabilities in Other 'Form Factors'**  
**Credit- and Debit-cards; RFID and NFC tags**

## Contactless Cards

- **eTags for Toll-Roads**  
Operate autonomously  
Limited audit-trail; difficult to challenge
- **Tap-On-and-Off – Public Transport Tickets**  
HK Octopus, London Oyster, Qld GoCard,  
ACT Myway, Vic MyKi, NSW Opal
- **Tap-and-Pay – Visa PayWave, MasterCard PayPass**  
PIN-less up to c. \$100, with no docket necessary



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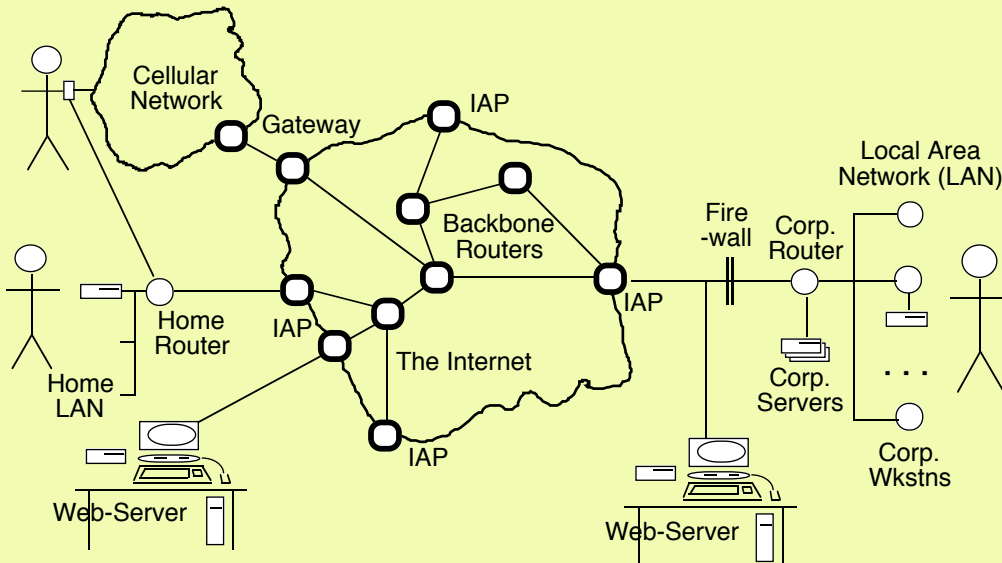
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- **Processing Capabilities in Other 'Form Factors'**  
**Credit- and Debit-cards; RFID and NFC tags**
- **Wearable Computing Devices**  
**Watches**, finger-rings, spectacles, key-rings, necklaces,  
bracelets, anklets (fashion or imposed), body-piercings, ...

## 2. Network-Connected Devices

- Hosts ('Servers')
- Desktops
- Laptops
- Handhelds
- Other Form-Factors, e.g. Cards
- Wearables
- Embedded in 'Things'
- Embedded in Animals
- Embedded in Humans

## Generations of User Interface

- **Command-Line Interfaces**  
1960s onwards  
Now associated with Unix shells
- **Graphical User Interface (GUI)**, with  
Mouse / Roller-Ball / Track-Pad / ...  
1981 (Xerox Star), 1983 (Lisa), 1984 (Mac)
- **Gesture-Based Interfaces**  
2D, 'touch'-sensitive screens, 2007 (iPhone)  
3D, with Haptic technologies
- ... [Watch this space] ...



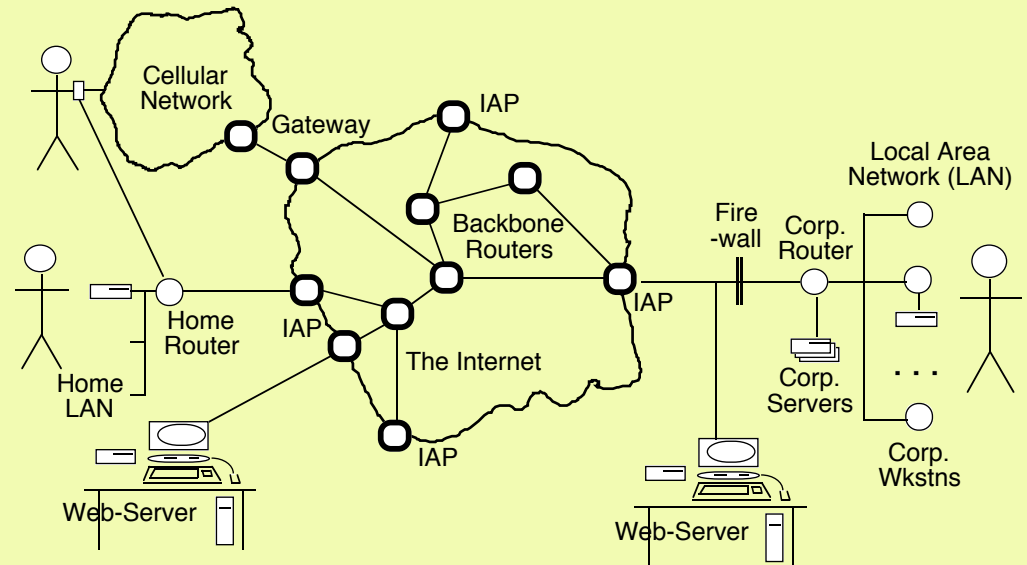
## 3. Network Infrastructure Services

- **'Permanent' Storage**  
Device-Level, Removable,  
Local/NAS, Remote,  
Remote Distributed, Remote Replicated
- **Temporary Storage**  
Local Buffers, Layers of Caches
- **Intermediary Nodes**  
Routers – Local and Backbone  
Proxies, Reverse-Proxies



## Intermediary Nodes

- **Router**  
An intermediating node that connects networks and passes data between devices on each of them
- **Proxy-Server**  
An intermediating node that assists requesting devices by passing requests on to a particular service, e.g. anilib access to journals databases, and web and email anonymisers
- **Reverse Proxy-Server**  
An intermediating node that assists responding devices by passing requests on to a particular service, e.g. to load-balance across web-servers



## 4. Uses and Abuses

- From Local Software to Remote Services
- From Friendly-Web to Spider-Web ('Where do cookies come from')
- Bitcoin  
Blockchains more generally

## Consumer Computing

### Functions

### Applications 1975-2000

#### Email

Email clients, using  
smtp/pop/imap

#### Personal Galleries

Personal Web-Sites

#### Personal Music

Dedicated Devices

#### Doc Prep

Office on the Desktop

#### File-Sharing

FTP-server and -client

## Consumer Computing

**Functions**      Applications ==>>      **Services**  
1975-2000                                  2000-

<u>Email</u>	Email clients, using smtp/pop/imap	Webmail, using http / https
<u>Personal Galleries</u>	Personal Web-Sites	Flickr, Picasa, ...
<u>Personal Music</u>	Dedicated Devices	iTunes, ...
<u>Doc Prep</u>	Office on the Desktop	Zoho, GDocs, MS365
<u>File-Sharing</u>	FTP-server and -client	Dropbox, ...

## Consumer Requirements and Risks – 1 of 3

### The Basic Needs

- Does it do what I want it to do? [Fit]
- Will it be there when I want it? [Availability, Reliability]

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### The Basic Needs

- Does it do what I want it to do? [Fit]
- Will it be there when I want it? [Availability, Reliability]

### The Basic Protections

- How do I keep going if it stays fallen over for a long time? [Service Interruptions]
- Will you respond helpfully and quickly enough when I ask for help? [Customer Service]
- Will you lose my data, or muck it up? [Data Integrity]
- Do I get my data back if you fall over or withdraw the service? [Survival]
- Can I move my data to another supplier? [Lateral Compatibility]
- Who can I complain to if I get duded, and will they actually help me? [Consumer Protection]

## Consumer Requirements and Risks – 2 of 3

### More Advanced Needs

- Will it keep doing what it does now? [Service Integrity]
- Will it stay up-to-date? [Future Fit]
- Will it fall over too often? [Robustness]
- Will it come back quickly after it falls over? [Resilience]
- Is my service protected against you, them and the gods? [Service Security]
- If bits of it are broken, will you fix it without breaking it some more? [Maintainability]
- Can I fiddle with it a bit if I need to? [Flexibility]
- Can I move my data to an upgraded version? [Forward Compatibility]
- How long will old versions keep working for me? [Backward Compatibility]
- Am I breaking the law if I use the service? [Legal Compliance]

## Consumer Requirements and Risks – 3 of 3

### More Advanced Protections

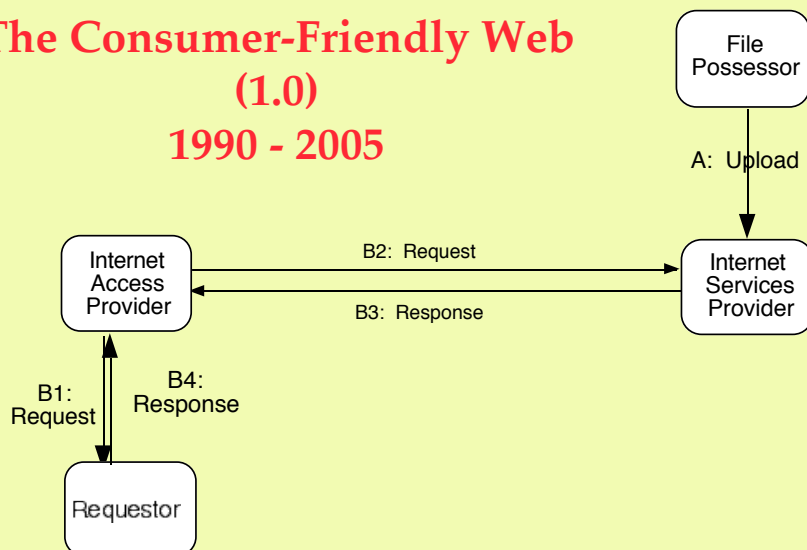
- Am I going to get gouged? [Cost]
- Can only appropriate people get in and do things? [Authentication and Authorisation]
- Can I get access to all data that you hold about me? [Subject Access]
- Is my data protected against you, them and the gods? [Data Security]
- Is my privacy protected against you, them and the gods? [Privacy Controls]
- If I terminate our relationship, will my data be irretrievably deleted? [Fully Effective Withdrawal]
- What happens to my data if I die? [Archival / Memorialisation]

## LinkedIn, In-Depth

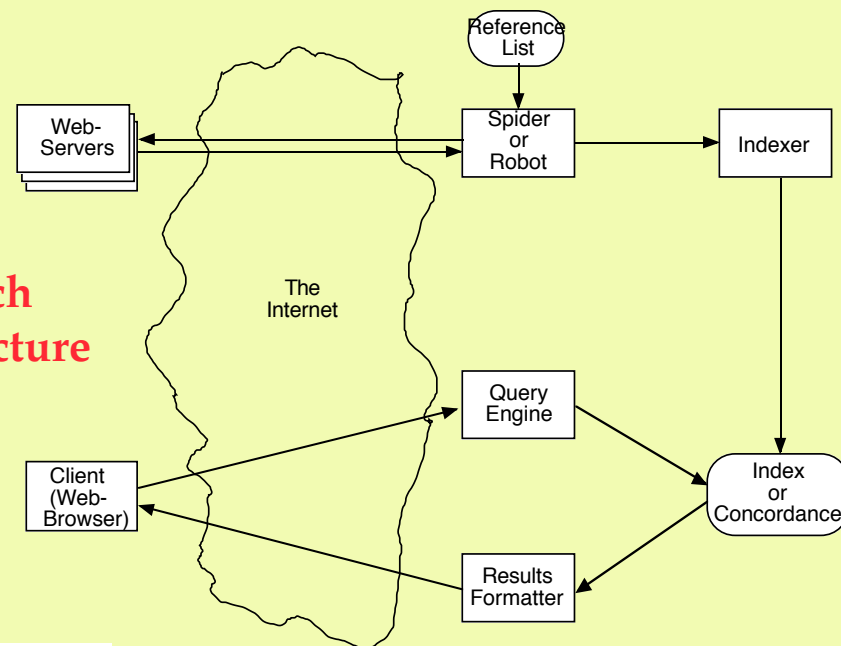


- **No responsibility to provide the service**, to do so reliably, or to sustain data stored in it
- **Subscribers must disclose physical location**, even if irrelevant
- No internal complaints process
- No rights to restitution, **no liability** for identity fraud
- **LinkedIn gains rights to customers' data** that are almost equivalent to the rights of the customers themselves
- **Unilateral changes to the Privacy Statement, without notice**
- Storage in the USA under lax privacy laws
- No undertakings to control the behaviour of staff
- **Enforced 'permission' to disclose personal data**, without legal authority, **"to assist government enforcement agencies"**
- **Inadequate subject access and correction rights**

## The Consumer-Friendly Web (1.0) 1990 - 2005



## Search Architecture





## Cookie Processing

- Each time a user requests a page, **the browser checks whether a cookie exists** that has been designated to be sent to such a web-server (based on domain-name)
- If so, the browser transmits the cookie-data to the server, along with the GET request for the page
- **The server is able to use the data in the cookie to 'remember' something about the user**
- This may be done with or without user-**consent**

## The Upside

- Cookies can be used for user-profile data, controlled by the user, containing membership-numbers, login-ids (and perhaps passwords??), user-interface preferences, and search-related data (such as areas of interest and common synonyms)

## The Downside

- Marketers use them to maintain user-profile data, on the user's own machine, without consent
- Marketers form strategic partnerships to exchange that data, to pool their user-profile information

## JavaScript / ECMAScript / JScript

- Javascript is an extension to the HTML specification
- It enables the web-page designer to cause the web-browser to perform some kinds of processing
- One very effective use is to check whether a form that the user is about to send to the server contains all of the required data
- But:
  - implementation details vary across browsers
  - its use can cause accidental harm
  - it is insecure, and is used for harmful purposes

## Three Views of Web 2.0

- The Communitarian  
*Collaborate*
- The Technical  
*Get inside users' devices and do things*
- The Marketer / 'Neo Dot.com' Movement  
*Make money by exploiting collaboration*

## The Spider-Web (2.0) 2005 – ...

- Web-Browsers and the http Protocol are designed to facilitate Servers' needs
- Server-supplied code runs inside browsers
- Web-Browsers ask for a web-page but instead:  
Web-Servers deliver active code  
Web-Servers 'invite' many other, uninvited  
Web-Servers to deliver active code

## Will People Eventually be Banned From Controlling General-Purpose Computing Devices?

Some powerful groups might like to achieve it

- Copyright-Dependent Corporations
- Government Censors
- The Moral Minority, who want governments to extend censorship to whatever content the moral minority thinks the immoral majority shouldn't have access to
- (Dominant) Computing Device Providers
- Law Enforcement & National Security Agencies (LEANs)
- 'Fraud Experts'

## Bitcoin

- A digital asset and payment system which operates on a decentralised basis, whereby transactions are checked against a public register replicated on many nodes

## 'Blockchain'

- A replicated database storing an accounting 'ledger' which contains 'blocks' of data which comprise all or some recent 'valid' transactions. The blocks are 'chained' in that each includes the hash of the prior block, enabling controls and audit.  
(In Bitcoin, 'valid' = digitally signed transfers of available value).

## 1. Network Infrastructure Agenda

- **Networks**  
Wired and Unwired
- **Devices**  
'Form-Factor', Power, Mobility
- **Intermediary Services**  
Storage Layers, Intermediaries
- **Uses & Abuses**  
Remote Services, Spider-Web, Entropic Services

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