IT Architecture Module

Qualities & Constraints in IT Architecture

Part II –

Security
Usability & Accessibility
Maintainability & Flexibility

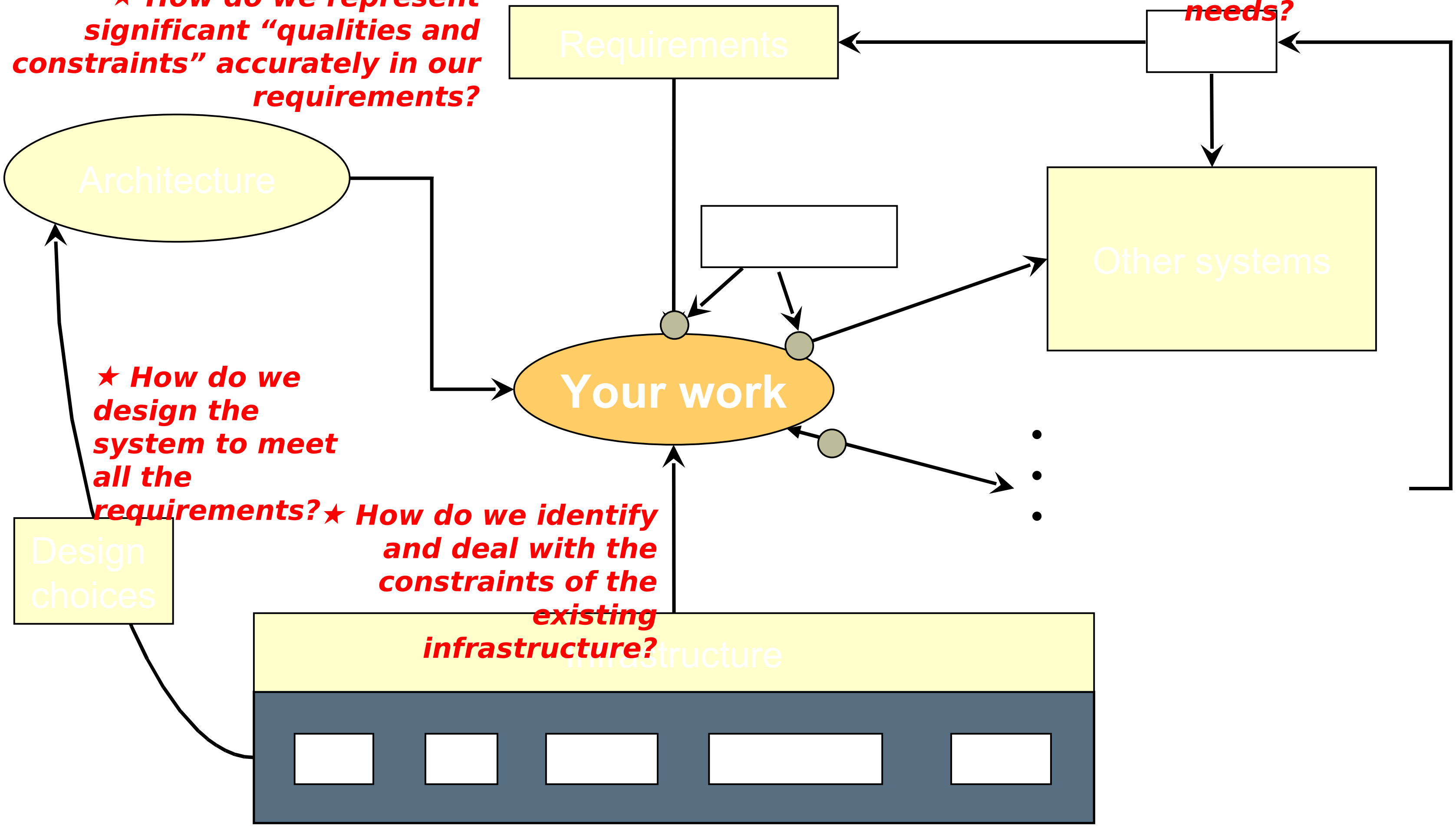
Agenda (Part I - previously)

- *Qualities & Constraints in IT Architecture – overview*
  - What are “qualities and constraints” in IT Architecture?
  - Non-Functional Requirements and their quality
- Focus on *Availability*
  - Availability modelling
  - Availability design techniques
- Focus on *Performance*
  - The Performance Engineering Lifecycle
  - Volumetrics
  - Estimation and Modelling
  - Optional exercise

Agenda (Part II – this lecture)

- Focus on *Security*
- Focus on *Usability & Accessibility*
- Focus on *Maintainability & Flexibility*

(Reprise from ‘WDITADAD?’) “The wider context”



★ How do we identify all significant user needs?

★ How do we represent significant “qualities and constraints” accurately in our requirements?

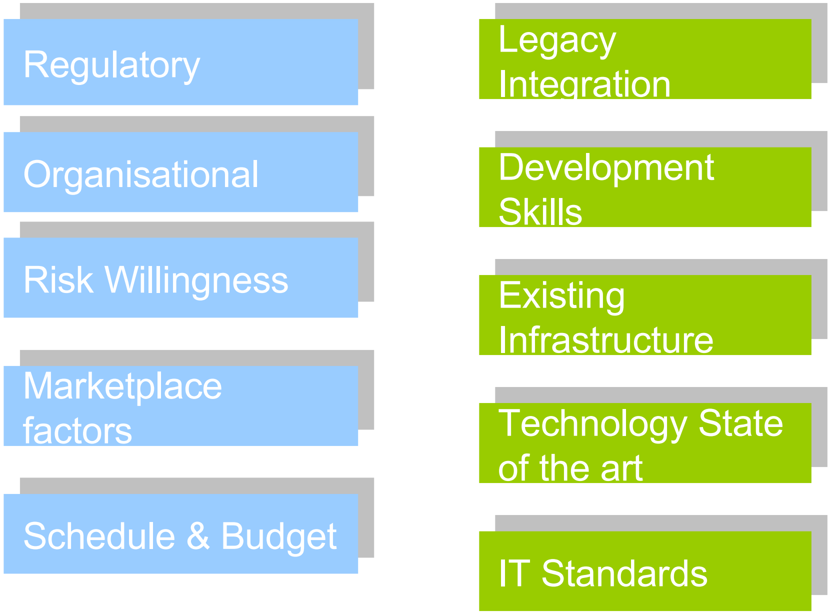
★ How do we design the system to meet all the requirements?

★ How do we identify and deal with the constraints of the existing infrastructure?

(Reprise) Constraints

- **The business aspects of the project, customer's business environment or IT organization that influence the architecture**

- **The technical environment and prevailing standards that the system, and the project, need to operate within**



Regulatory

Organisational

Risk Willingness

Marketplace factors

Schedule & Budget

Legacy Integration

Development Skills

Existing Infrastructure

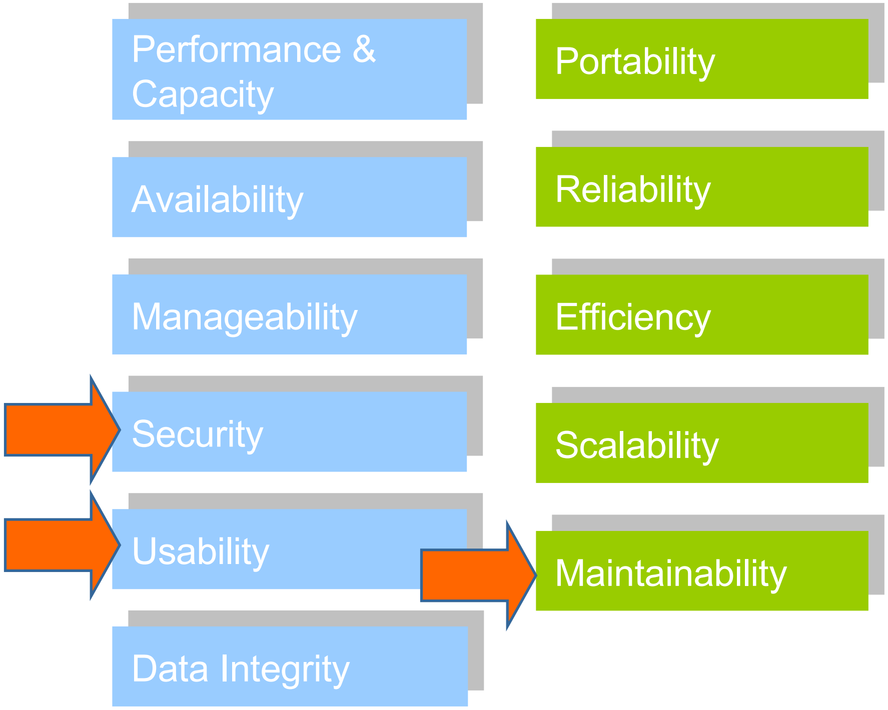
Technology State of the art

IT Standards

(Reprise) Qualities

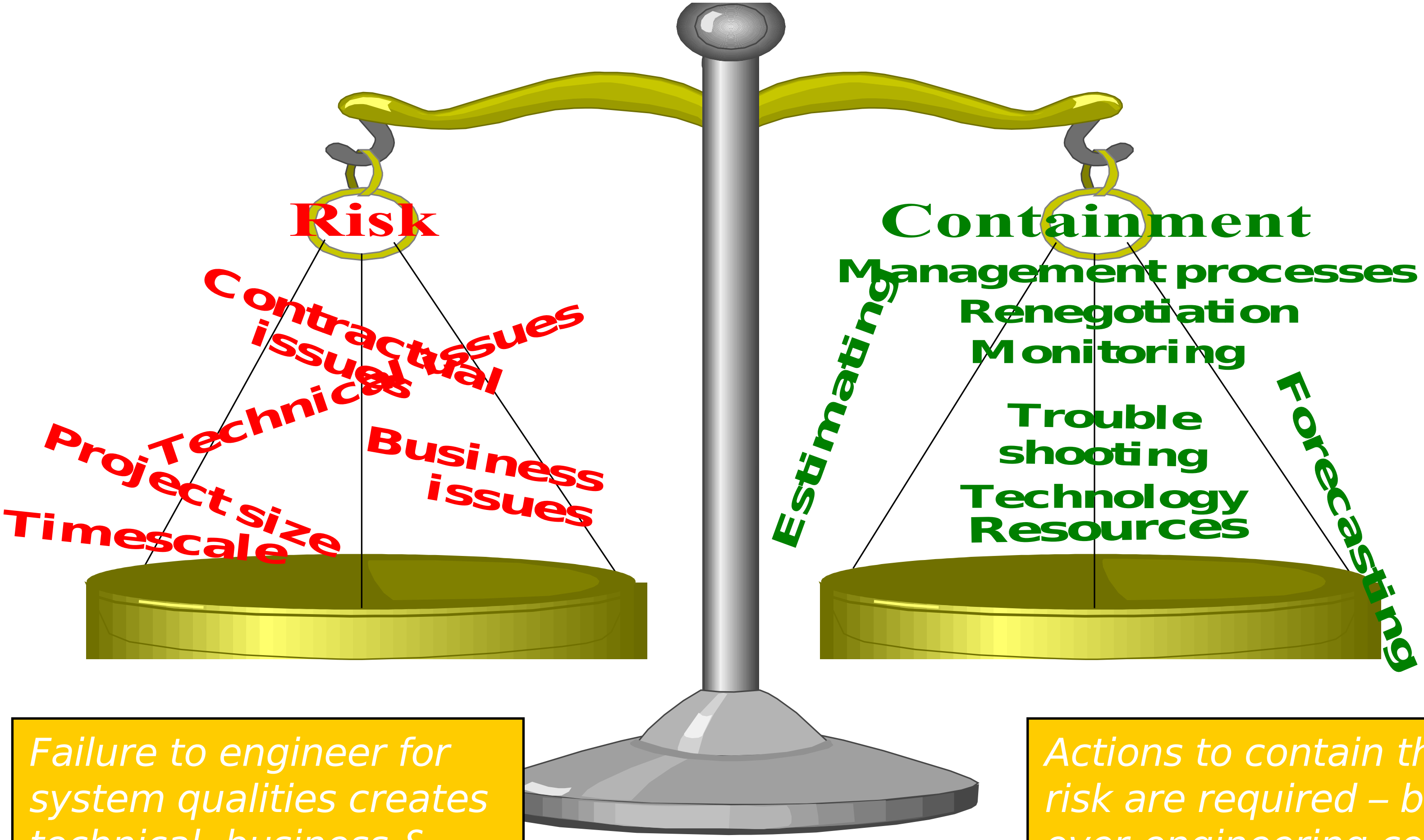
- **Runtime qualities are ‘measurable’ properties, often expressed as “Service Level Requirements”.**

- **Qualities might also be related to the development, maintenance, or operational concerns that are not expressed at runtime.**



focus of this session

(Reprise) Beware: a BALANCE must be maintained between *risk* and *cost*



Risk

Contractual issues

Technical issues

Business issues

Project size

Timescale

Containment

Management processes

Renegotiation

Monitoring

Trouble shooting

Technology

Resources

Estimating

Forecasting

Failure to engineer for system qualities creates technical, business & commercial risks

Actions to contain the risk are required – but over-engineering could be unnecessarily costly

Security in IT Architecture

Defining Security

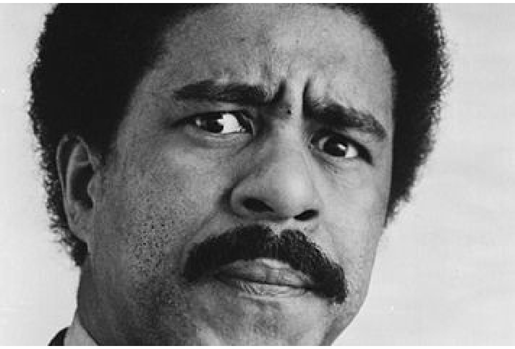
- Security is a wide and fascinating topic encompassing a vast range of issues, arenas and disciplines
  - from deep mathematics to international espionage
- In IT systems, “security” can be associated with the following qualities:
  - Not open to intentional misuse
  - Not open to accidental misuse
  - Protects the truth – maintains integrity
  - Protects service in the face of attack (overlap with Availability)
- Secure means SAFE:
  - Your data, your assets, your reputation

(Amusing?) Examples of insecure systems

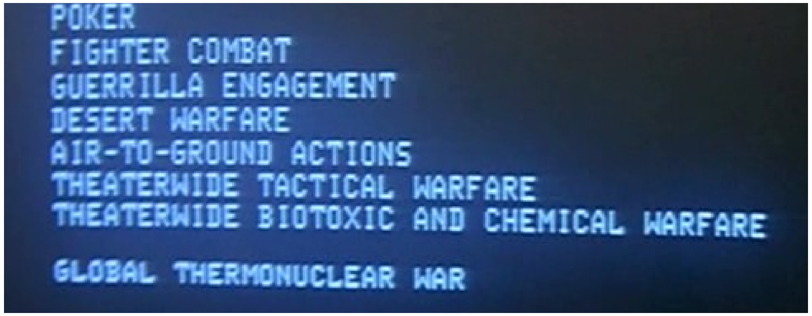
- Superman III – Richard Pryor's character bypasses access controls by typing:

```
> override all security
```

.. into the console



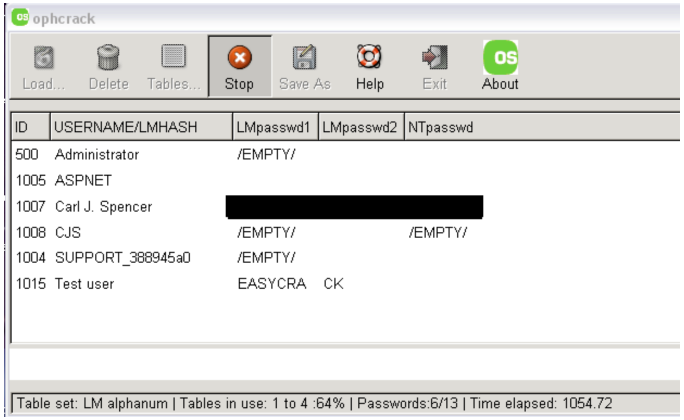
- In the film "War Games", Matthew Broderick gains access to the WOPR computer using a password "backdoor"



```
POKER
FIGHTER COMBAT
GUERRILLA ENGAGEMENT
DESERT WARFARE
AIR-TO-GROUND ACTIONS
THEATERWIDE TACTICAL WARFARE
THEATERWIDE BIOTOXIC AND CHEMICAL WARFARE

GLOBAL THERMONUCLEAR WAR
```

- Tools freely available to "hack" your Windows passwords (e.g. OPHCRACK)



ID	USERNAME/LMHASH	LMpasswd1	LMpasswd2	NTpasswd
500	Administrator	/EMPTY/		
1005	ASPNET			
1007	Carl J. Spencer	[redacted]	[redacted]	[redacted]
1008	CJS	/EMPTY/		/EMPTY/
1004	SUPPORT_388945a0	/EMPTY/		
1015	Test user	EASYCRA	CK	

Table set: LM alphanum | Tables in use: 1 to 4 :64% | Passwords:6/13 | Time elapsed: 1054.72

Security is a critical concern in IT Architecture

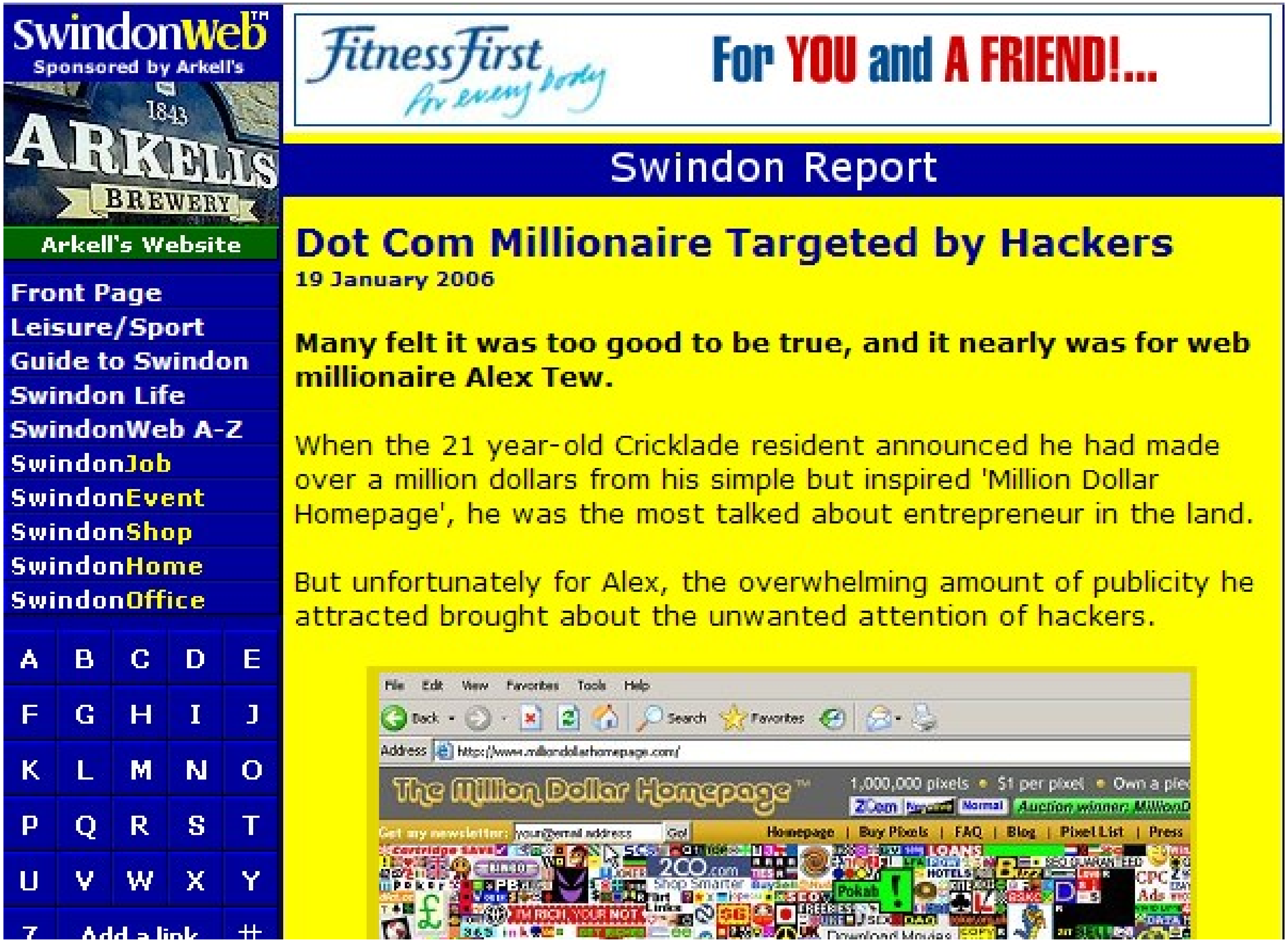
- Wherever systems are responsible for important data and processing, there is a risk that misuse of the system leads to a negative outcome for those associated in any way with that system
  - Typically in a commercial setting, IT Architects need to think about protecting our customers (e.g. a bank)
  - … and *their* customers (e.g. an account holder)
  - (… and both our reputations!)

- The scale of the risk depends on the nature of the organisation(s) and the nature of the purpose of the system …

Scale of Security Risk – from war to web browsing

Arena	Sample applications	Example risks
Military systems	Identify Friend or Foe (e.g. aircraft) Nuclear command and control	Prevent identification, present false identity (lose battle => lose war) Unauthorised use of nuclear weapon (e.g. in unstable state)
High value financial systems	Payment instruction exchange (e.g. SWIFT), foreign exchange, stock trading	Money siphoning; value alteration Lax controls (e.g. Barings back – Nick Leeson)
Retail banking	ATMs, Online banking	Expose private data Fraud – e.g. false transactions initiated (loss of money)
Home computing	Email, word processing, web browsing, picture management	Virus attack – data corruption, loss of data, … Privacy invaded (files accessed)

The business ‘bottom line’ can be very publicly affected



Dot Com Millionaire Targeted by Hackers

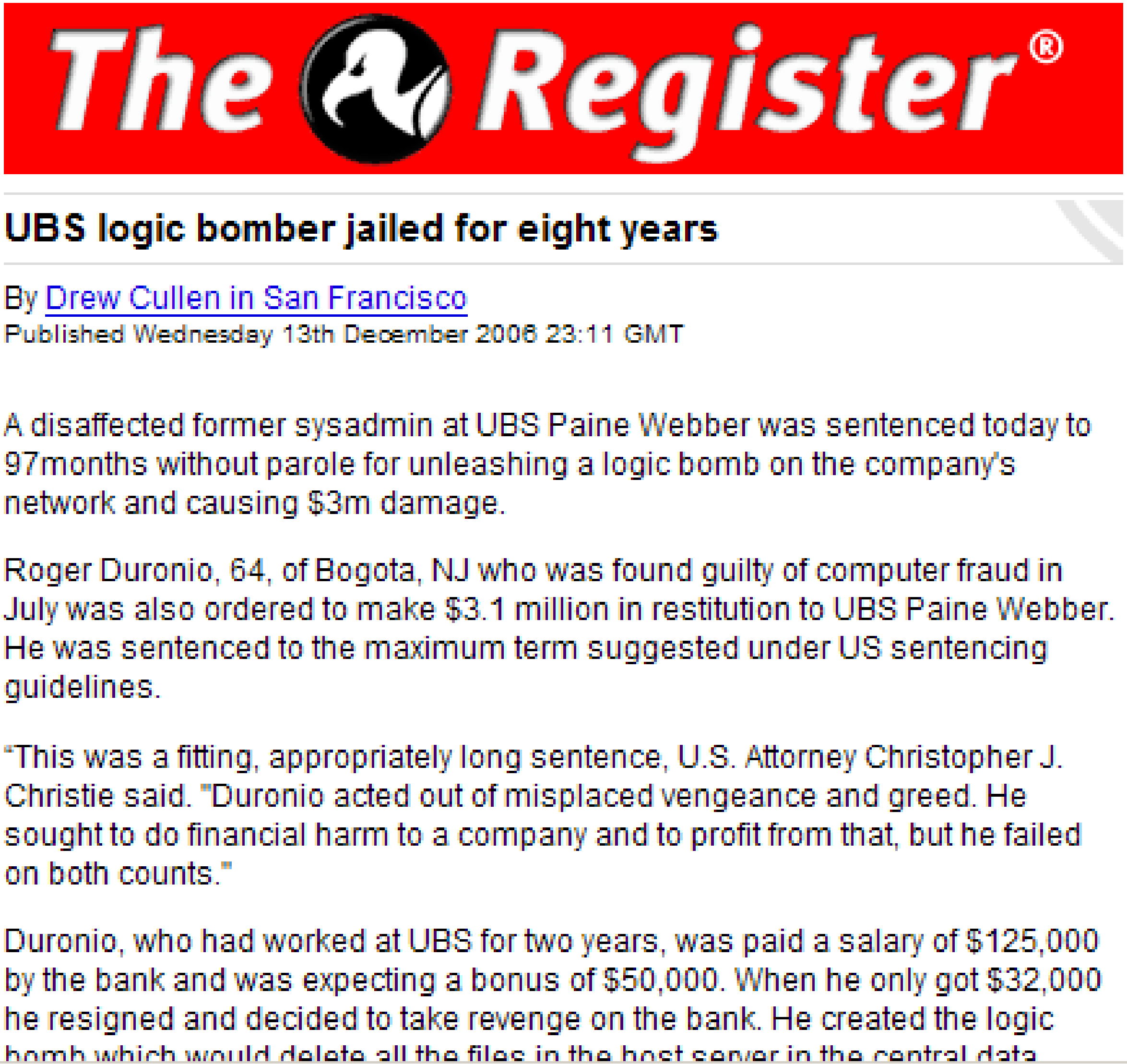
19 January 2006

Many felt it was too good to be true, and it nearly was for web millionaire Alex Tew.

When the 21 year-old Cricklade resident announced he had made over a million dollars from his simple but inspired 'Million Dollar Homepage', he was the most talked about entrepreneur in the land.

But unfortunately for Alex, the overwhelming amount of publicity he attracted brought about the unwanted attention of hackers.

But most attacks are not external ...



UBS logic bomber jailed for eight years

By Drew Cullen in San Francisco
Published Wednesday 13th December 2006 23:11 GMT

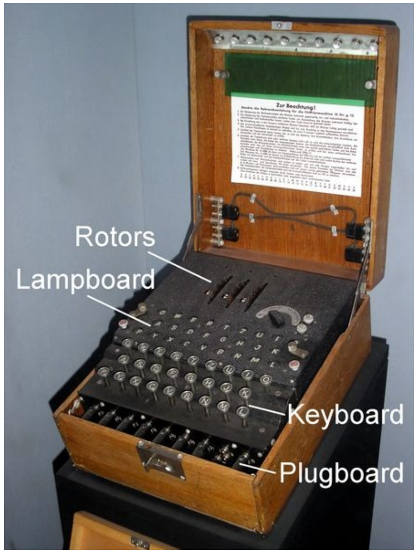
A disaffected former sysadmin at UBS Paine Webber was sentenced today to 97months without parole for unleashing a logic bomb on the company's network and causing $3m damage.

Roger Duronio, 64, of Bogota, NJ who was found guilty of computer fraud in July was also ordered to make $3.1 million in restitution to UBS Paine Webber. He was sentenced to the maximum term suggested under US sentencing guidelines.

“This was a fitting, appropriately long sentence, U.S. Attorney Christopher J. Christie said. "Duronio acted out of misplaced vengeance and greed. He sought to do financial harm to a company and to profit from that, but he failed on both counts."

Duronio, who had worked at UBS for two years, was paid a salary of $125,000 by the bank and was expecting a bonus of $50,000. When he only got $32,000 he resigned and decided to take revenge on the bank. He created the logic bomb which would delete all the files in the host server in the central data

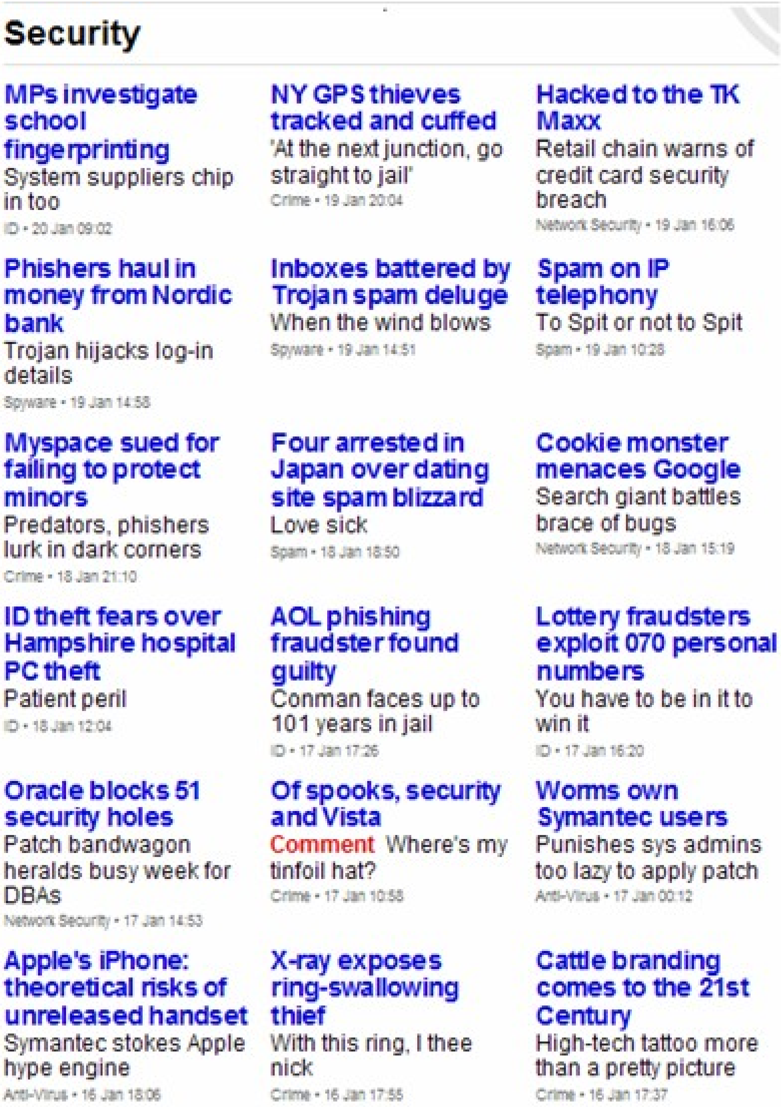
Other well known examples



- Enigma machine
  - Pioneering British “cryptanalysts” (Alan Turing et al.) changed the course of the Second World War by breaking the Enigma code
- Automatic Teller Machines (ATMs)
  - the first widespread transaction processing systems exposed to the public (since 1968!)
  - first wide scale use of modern block ciphers to generate and verify PINs
  - tamper resistant hardware
- Chip & PIN
  - May 2006 – Shell garages stopped accepting Chip and PIN transactions at 600 petrol stations
  - (amusing video from Ross Anderson on YouTube of a compromised PIN pad)
- Your NHS record
  - campaign to prevent uploading of your records to the central NHS database (www.TheBigOptOut.org)

Security is an increasingly "hot topic"

- The list of stories show how 'hot' a topic it is
  - All of these headlines were between 16th and 20th Jan 2007
- Businesses and users really care about security … especially when it is compromised
- Why do we think this is?



Security

MPs investigate school fingerprinting
System suppliers chip in too
ID • 20 Jan 09:02

NY GPS thieves tracked and cuffed
'At the next junction, go straight to jail'
Crime • 19 Jan 20:04

Hacked to the TK Maxx
Retail chain warns of credit card security breach
Network Security • 19 Jan 16:06

Phishers haul in money from Nordic bank
Trojan hijacks log-in details
Spyware • 19 Jan 14:58

Inboxes battered by Trojan spam deluge
When the wind blows
Spyware • 19 Jan 14:51

Spam on IP telephony
To Spit or not to Spit
Spam • 19 Jan 10:28

Myspace sued for failing to protect minors
Predators, phishers lurk in dark corners
Crime • 18 Jan 21:10

Four arrested in Japan over dating site spam blizzard
Love sick
Spam • 18 Jan 18:50

Cookie monster menaces Google
Search giant battles brace of bugs
Network Security • 18 Jan 15:19

ID theft fears over Hampshire hospital PC theft
Patient peril
ID • 18 Jan 12:04

AOL phishing fraudster found guilty
Conman faces up to 101 years in jail
ID • 17 Jan 17:26

Lottery fraudsters exploit 070 personal numbers
You have to be in it to win it
ID • 17 Jan 16:20

Oracle blocks 51 security holes
Patch bandwagon heralds busy week for DBAs
Network Security • 17 Jan 14:53

Of spooks, security and Vista
Comment Where's my tinfoil hat?
Crime • 17 Jan 10:58

Worms own Symantec users
Punishes sys admins too lazy to apply patch
Anti-Virus • 17 Jan 00:12

Apple's iPhone: theoretical risks of unreleased handset
Symantec stokes Apple hype engine
Anti-Virus • 16 Jan 18:06

X-ray exposes ring-swallowing thief
With this ring, I thee nick
Crime • 16 Jan 17:55

Cattle branding comes to the 21st Century
High-tech tattoo more than a pretty picture
Crime • 16 Jan 17:37

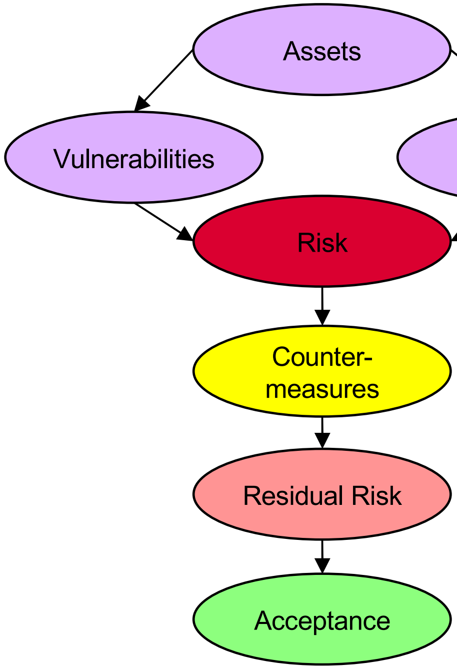
Impact to businesses

- Fraud and theft of data and other assets
  - Bottom line losses, e.g. 2006 CSI/FBI Computer Crime and Security Survey
    - Survey of 313 businesses of various sizes in the US
    - Average loss per respondent: $167,713
- Loss of Reputation and trust
  - Will customers trust companies that can’t look after their data?
- Disruption to operations
  - This is not about creating new value
- Cost of enforcing security – ref. balancing scales
  - From the same survey: combined average annual security expenditure per employee: $1,349 for businesses with revenues < $10m

A good general approach to tackling IT security is to take a ‘threat-based’ approach

- **Document assets**
  - Identify and decide what you need to protect. This could be data, intellectual capital, processes, physical resources, or any other thing of value in the organisation
- **Understand threats**
  - Know your enemy. Determine from whom or what are you protecting your system and/or network
- **Define policy**
  - Create a comprehensive security policy and implementation plan which is appropriate to the level of threat
- **Implement policies**
  - Apply the security policies to your organisation and systems
  - Update or include security elements and configurations in IT solutions
- **Monitor policy**
  - Continually monitor to detect any deviation from your policies and take actions if needed

Threat assessment needs to be combined with assessment of vulnerabilities to determine risk



A simplified view of the Risk Assessment process

- Information security **risk** can be viewed as the **cost** to an organisation of **compromise or damage** to an information asset
- There are many ways to assess risk, some formal and **quantitative**, some informal and **qualitative**.
- In all cases, the purpose is to identify **significant threats** and address them through appropriate **countermeasures**

- In general, to assess risk it is necessary to know:
  - **Threats** – the bad things that might happen to an information asset
  - **Vulnerabilities** – the ways those bad things might come to pass
  - **Likelihood** – the probability of a vulnerability being exploited to make a bad thing happen
  - The “**value**” or “**sensitivity**” of the asset – the impact on the organisation if a bad thing happened

Exercise 1 – Assets and threats

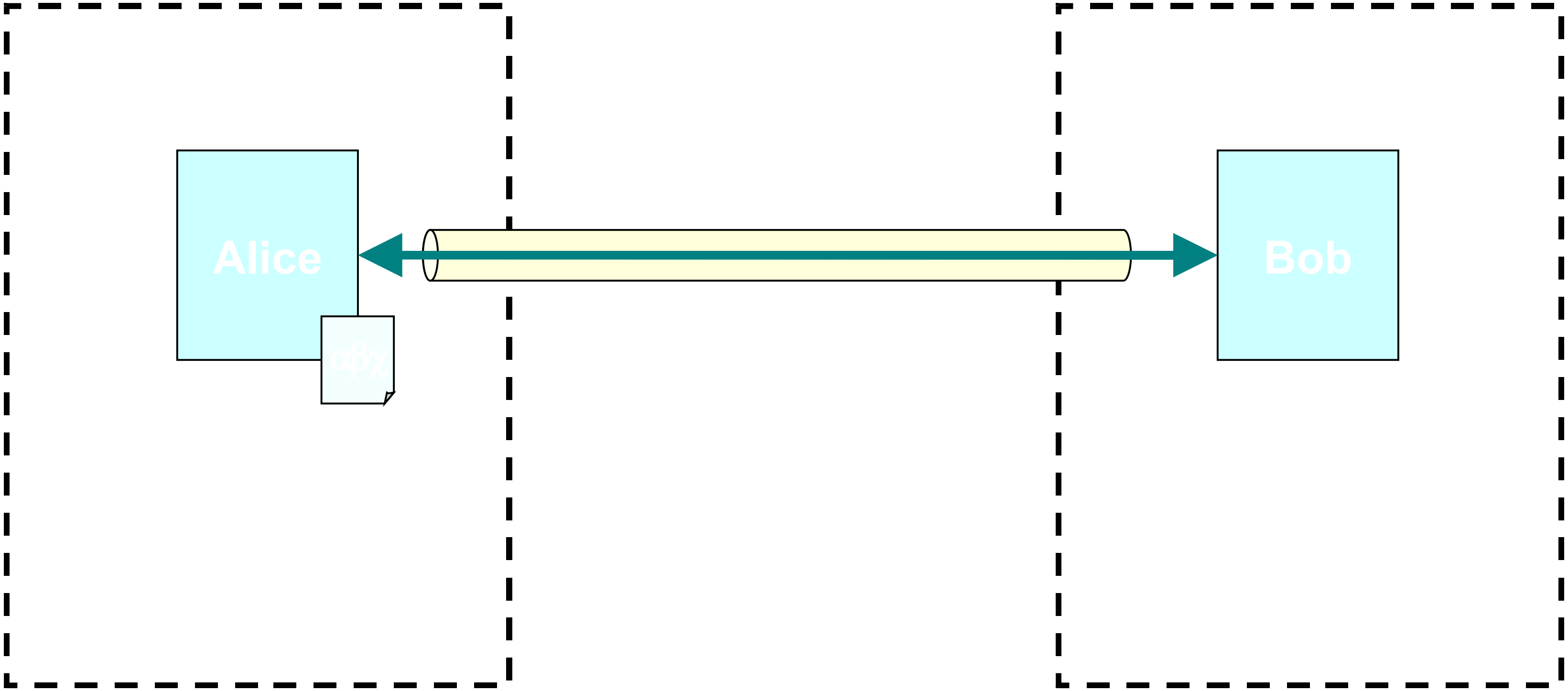
- Write down at least:
  - three assets that Ottomobil or similar organisation might want to protect
  - three threats that these might be prone to
- *Bonus mark:*
  - State at least policy you would implement to protect the assets you identified
- 5 minutes

A few examples of sensitive assets

- Data
  - Customer accounts
  - Financial information or other critical MI
  - Intellectual Capital
- Processes
  - Financial processes – e.g. ones with purchasing power
  - Command and control processes
  - Other privileged processes
- Physical / infrastructure
  - Equipment
  - Hardcopy data
  - Bandwidth
- Intangible
  - Reputation

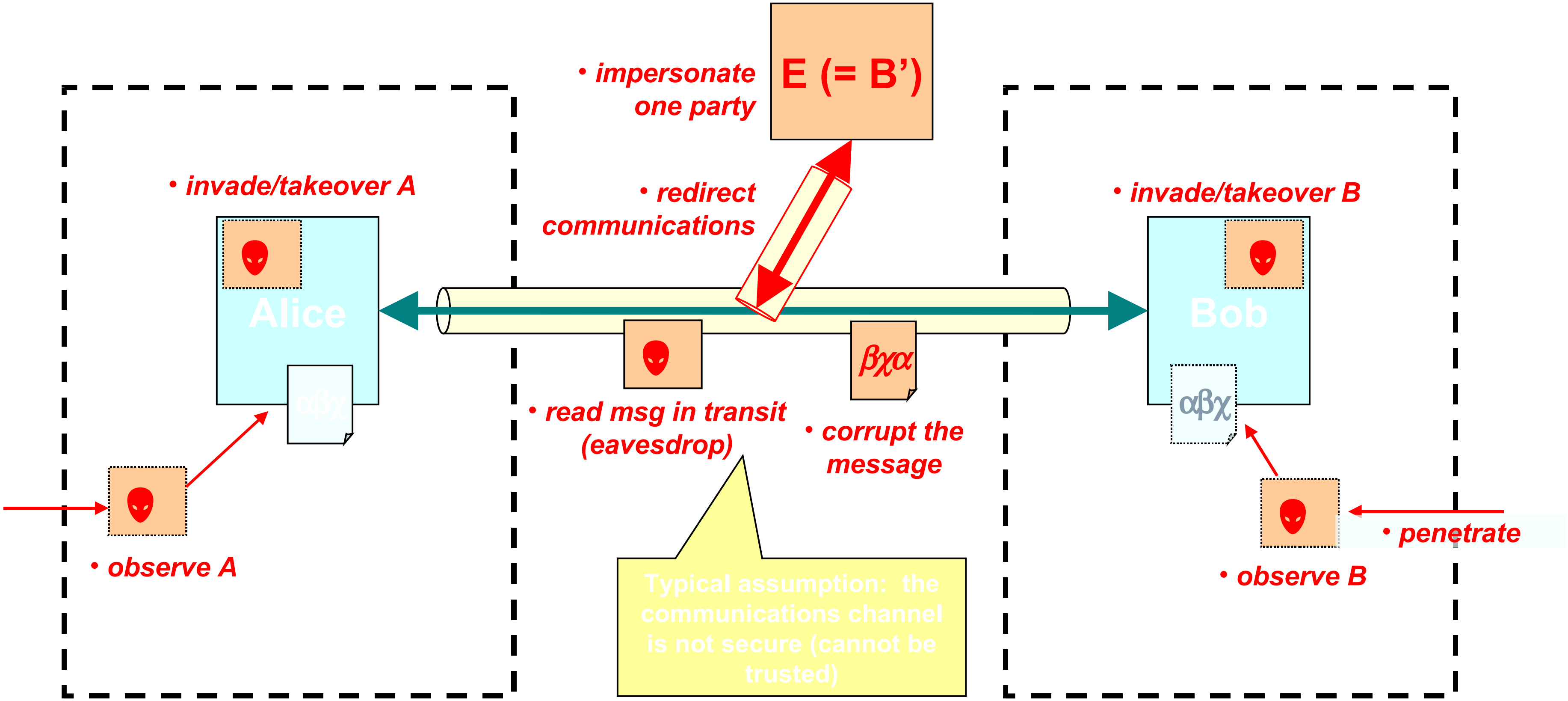
Security :
Fundamental Concepts

Consider: Alice wants to send a message to Bob (securely)



Exercise 2: In what ways can we “attack” the communications between A and B?

Consider: Alice wants to send a message to Bob (securely)



- *impersonate one party*
- *invade/takeover A*
- *redirect communications*
- *invade/takeover B*
- *read msg in transit (eavesdrop)*
- *corrupt the message*
- *penetrate*
- *observe A*
- *observe B*

Typical assumption: the communications channel is not secure (cannot be trusted)

=> Threats arise at both ends and everywhere in between

Threats - Where do threats arise from in IT System? And what can they do to us?

- Malicious
  - third party motivated to make money or other gain
  - competitor or parties acting on behalf of a competitor
  - hacker seeking “kudos”
  - employee seeking personal gain or to inflict damage on the corporation
- Unwitting
  - damage to assets through accidental action (insufficient safeguards)
  - accidental sharing of confidential information
  - program / system errors causing corruption or violating rules
- Combinations

- What can they do to us?
  - Observe, capture and forward confidential data
  - Alter data (to alter outcomes)
    - includes reputation damage, e.g. web site defacement
  - Delete data
  - Initiate unauthorised processing
  - Prevent (or disrupt) authorised processing
  - Deny access / service
  - Reduce system security
    - to ease other attacks
  - Steal assets (physical or otherwise)
  - …

Other attack types and terms

- DoS (Denial of service)
  - An attack on a computer system or network that causes a loss of service to users, typically the loss of network connectivity and services by consuming the bandwidth of the victim network or overloading the computational resources of the victim system
- ‘Malware’
  - A generic term given to malicious code. Can include spyware, adware, viruses, worms and other scams
  - Made particularly common by the Internet and the widespread use of the Windows operating system

Beginning the fight back: IT security relies ultimately on the products of cryptography (the science of designing ciphers)

- In order to protect the communications between A and B, we can encrypt the content of messages in transit
- A system of establishing and sharing keys (which are combined with the source message at time of sending) is required
- $\{\text{Plaintext}\}_{\text{Key}}$ => Ciphertext
- There are many different forms of encryption with varying properties and levels of protection
- The most commonly used algorithms in commercial systems are "Block ciphers", which come in two flavours:
  - Symmetric key – same key for encryption and decryption
    - e.g. the Data Encryption Standard (DES)
  - Asymmetric ("public") key – different keys for encryption and decryption
    - e.g. RSA, used in Secure Sockets Layer (SSL) on the web
- Key management itself is obviously critical and a significant challenge
- Cryptographic principles are used to build protocols which allow us to achieve objectives such as authentication

Key objectives of Security Engineering (1/2)

- **Authentication** – knowing who
  - The process of determining who users (human or otherwise) are and that they are who they claim to be. The most common technique for authenticating is by user ID and password. Others include certificate-based methods or biometrics
- **Authorisation** – knowing what can they do
  - The process of establishing the ‘rights’ that a user has to access and to perform actions on resources. (Simple example – the permissions to read and/or write a file)
- **Confidentiality** – protecting confidential data
  - Ensuring that data classed as confidential is only seen by appropriately authorised parties
  - Often achieved through cryptography – i.e. encrypting data

Key objectives of Security Engineering (2/2)

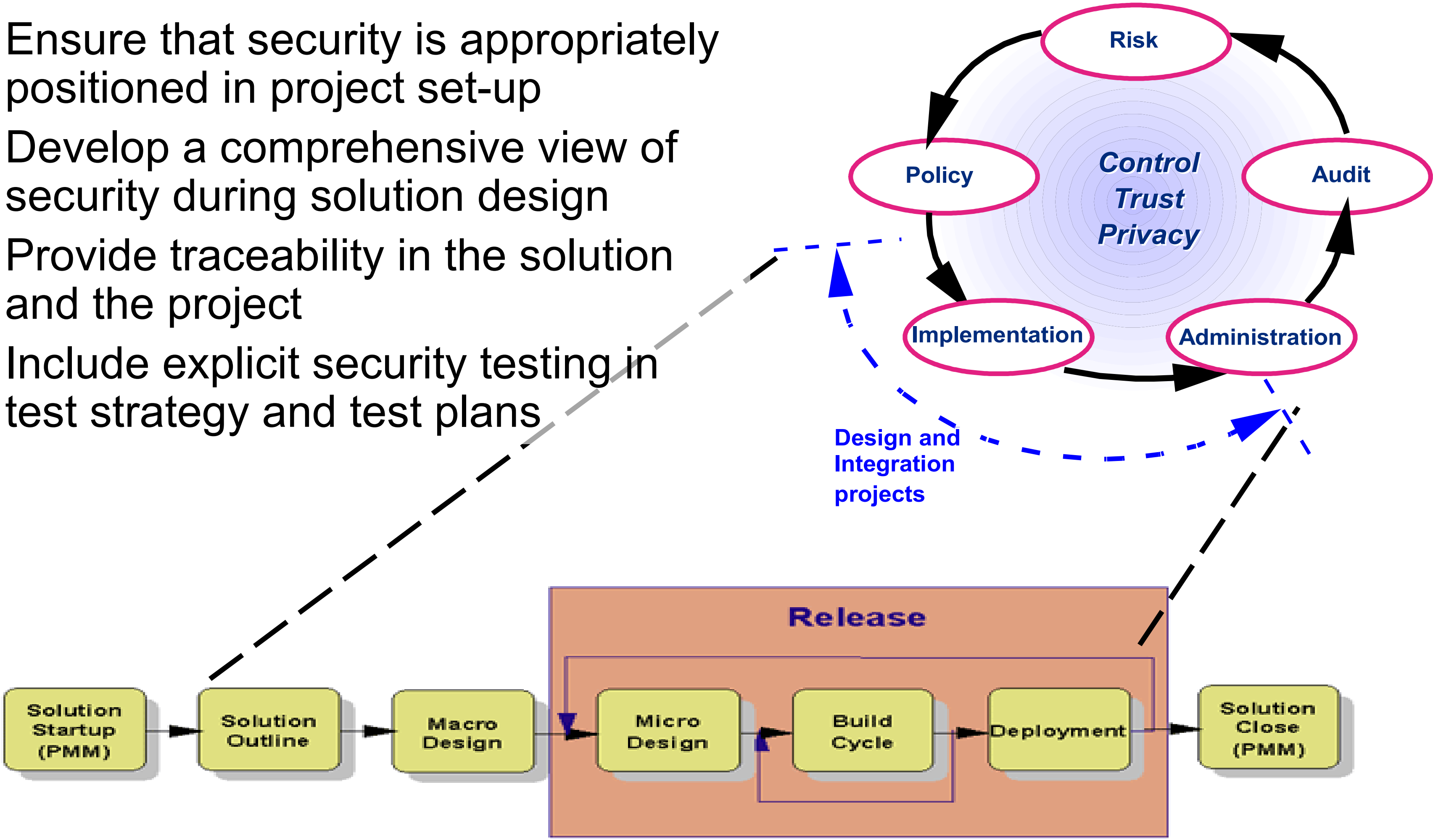
- **Integrity** – protecting the “truth”
  - The quality of a system whereby data and processing *always* conforms to the specified rules and constraints within the system
- **Auditable** – what did they do?
  - The trail of evidence proving the activities that have been performed on an internal asset – and attributing this to a known identity. This must be stored in a non-repudiable (tamper proof) format.
- **Non-Repudiation** – proving what happened happened
  - The ability to prove without contradiction that a transaction or event which is recorded as having taking place did take place
  - May need to be able to prove events in a court of law

Security :

Method and the Security Architect Role

The system design method should contain a risk-related approach to security

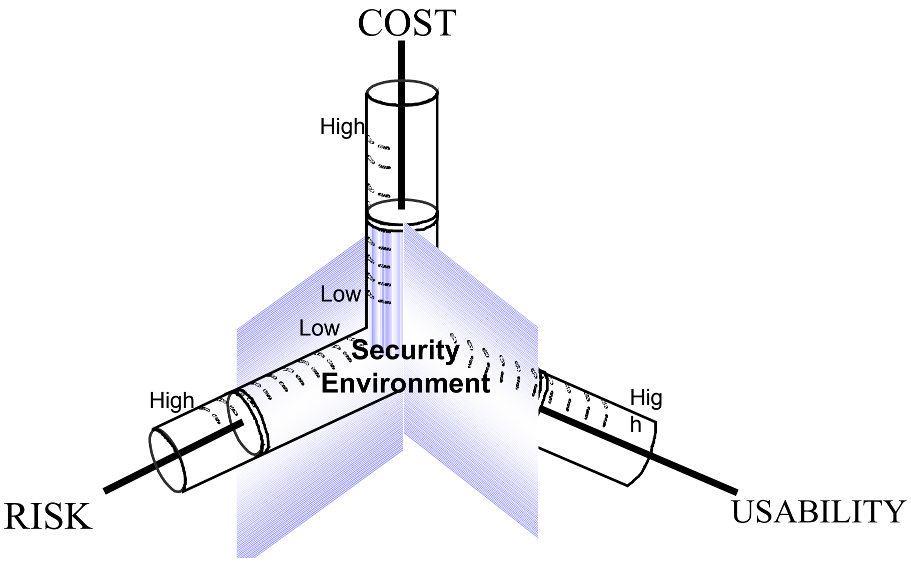
- Ensure that security is appropriately positioned in project set-up
- Develop a comprehensive view of security during solution design
- Provide traceability in the solution and the project
- Include explicit security testing in test strategy and test plans



At the solution outline phase, security architecture is about answering the question "how much security is enough (but not too much) security"

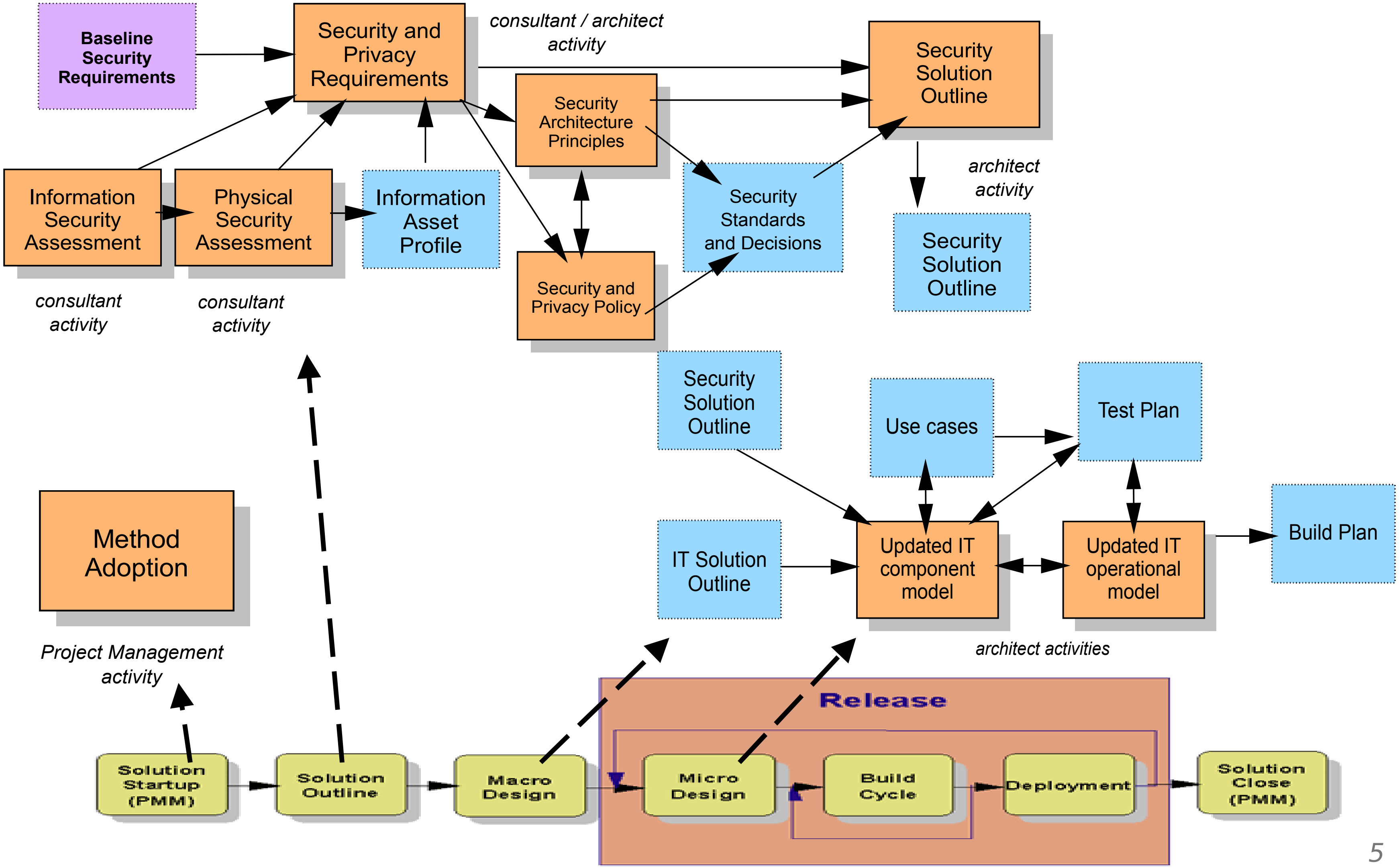
From a security perspective, all IT solutions must balance three conflicting factors:

- **The risk** – to the organisation
  - of operating the IT solution
- **The cost** – of implementing *and operating* the security controls
  - in general, the tighter the controls the lower the risk
- **The usability** – of the solution
  - in general, the tighter the controls, the greater the impact on the users of the system



- The resulting set of controls must be, as far as possible "**necessary** and **sufficient**".

Early efforts focus on the security requirements and relationship to business processes


Baseline Security Requirements
Security and Privacy Requirements
consultant / architect activity
Security Solution Outline
Security Architecture Principles
Information Security Assessment
Physical Security Assessment
Information Asset Profile
Security Standards and Decisions
architect activity
Security Solution Outline
Security and Privacy Policy
consultant activity
consultant activity
Security Solution Outline
Use cases
Test Plan
Method Adoption
IT Solution Outline
Updated IT component model
Updated IT operational model
Build Plan
Project Management activity
architect activities
Release
Solution Startup (PMM)
Solution Outline
Macro Design
Micro Design
Build Cycle
Deployment
Solution Close (PMM)

The "soup to nuts" view of a proactive security architect's role: addresses security issues at all phases in the lifecycle, across all the domains of the solution

		Phase				
		Solution	Macro Des	Micro Des.	Build	Deploy
Domain	Bus	Bus Env Asset Profile Risk Assess	Authorisation & Access Control Security Bus rules			
	Arch	Client IT Env Threat Analysis Security NFRs	Comp/Op Arch Security Test Strat Workstream Security	Authorised Dataflows		
	App	Security Use Case Model	Security Use Cases	Security Dev Standards	Security Testing Application Ethical Hacking	
	Ops		Security Process & Delivery Orgs	Dev/Test Security Define Security Baselines	Security Procedure development & implementation Implement Security Baselines	Infrastructure Ethical Hacking

Like other branches of the IT architecture process, Security Architects rely upon patterns for the basic structure of a solution

Reference architectures

- Provide patterns for a particular class of IT solutions – IBM maintains internal reference architectures for use by its architect community
- Reference architectures should include patterns for addressing security within an instantiation

Product/Supplier-specific patterns

- Security component suppliers often provide patterns that show how their products can be deployed as part of a business system
- IBM's *Patterns for eBusiness* has several patterns that show how an ebusiness solution can address security requirements - http://www.ibm.com/developerworks/patterns

Business solution level patterns

- For example the SAP security concept shows how the various package security controls are used, and identifies what controls the infrastructure must provide for secure operation

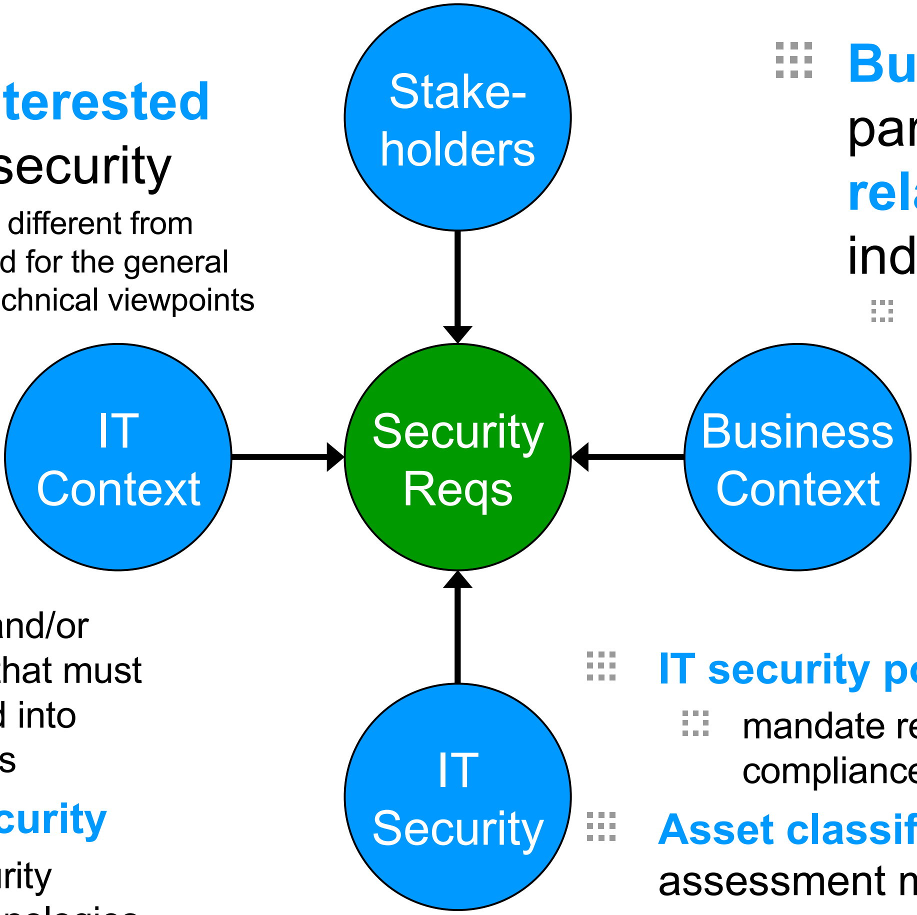
Function group patterns

- It is often useful to have conceptual model for a particular grouping of security function
  - IBM's security architecture methodology includes models showing the basic components that make up a particular service, an audit service for example
- Provides a model for analysing how the function is addressed within an architecture

Security :

Requirements & Functional Architecture

External to the project, security requirements come from understanding the business and technical context in which an application or service exists



- the set of **interested parties** for security
  - may look very different from those identified for the general business or technical viewpoints
- **Corporate IT architectures**
  - pre-requisites and/or dependencies that must be incorporated into security controls
- **Enterprise IT Security**
  - mandated security standards, technologies, and services

- **Business drivers,** partner **relationships**, industry **portals**, etc
  - influence the types of **trust relationships** and **access paths** that must be supported, and therefore the security controls required
- **IT security policies** and standards
  - mandate requirements – requiring compliance or exception
- **Asset classification** and risk assessment methods

Common influences in IT Security

- Conform to Corporate Security policies & standards
  - May include external and industry standards
  - Internally defined policies and procedures
  - Enforced usage of already selected technologies
- Minimising impact to users, e.g.
  - Single Sign On – the ability for a user to logon just once in order to be granted access to multiple systems
- Resilience – Maintain operations in the face of attack

Models for Security are commonly derived from recognised Standards in the field of Information Technology Security.

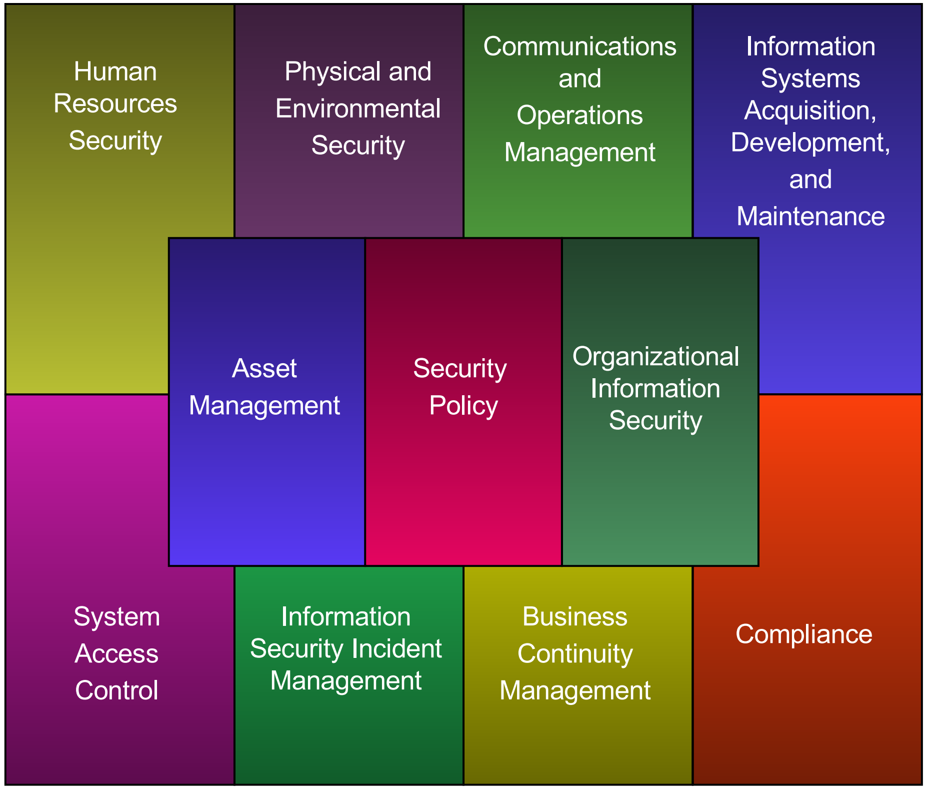
Security related Standards	General Description
National Government Standards US TCSEC (orange book), FIPS UK ITSEC CA CTCPEC	Sets of specifications and evaluation criteria for Trusted Computing products. *In most cases, these have been superseded by IS 15408,* ***Common Criteria.***
International Standard 7498-2 ISO/IEC 7498-2 (also ITU X.800)	System level security, to include: security services, mechanisms, management
International Standard 17799 ISO/IEC 17799 (also BS 7799)	Code of Practice for Information Security Management, including design and deployment of security processes, technology focus areas as well as compliance reviews`
International Standard 15408 ISO/IEC 15408 (also Common Criteria)	Combined and updated evaluation criteria from national security standards plus a product evaluation and certification method
Internet Reference Documents RFC 2196 Site Security Handbook RFC 2504 User Security Handbook RFC 2828 Internet Security Glossary	General guidance for site security and user security and security terminology for the Internet environment
Industry Group Standards J2EE Security (from Sun) PKIX (from Internet Mail Consortium) WS-Security	J2EE – Java PKIX – Public Key Infrastructure (digital certificates) WS-Security – family of standards specifying security services to support Web Services applications

Exploring the accepted standards for IT Security Systems

- ISO 17799 Code of Practice for Information Security Management (latest version ISO 17799:2005)
  - Helps to identify, manage, and reduce the range of threats to which information is regularly subjected.
- ISO 15408 Common Criteria (ISO 15408:-3:2005)
  - Defines a taxonomy for evaluating security functionality through a set of functional and assurance requirements.
- Good guidelines for developing computer security policies and procedures for sites that are connected to the Internet are available in the following documents and Web sites:
  - The Site Security Handbook, IETF RFC2196 http://tools.ietf.org/html/rfc2196
  - National Institute of Standards and Technology, Computer Security Division http://csrc.nist.gov/policies/index.html
  - Centre for Information Technology/Security http://irm.cit.nih.gov/security/sec_policy.html

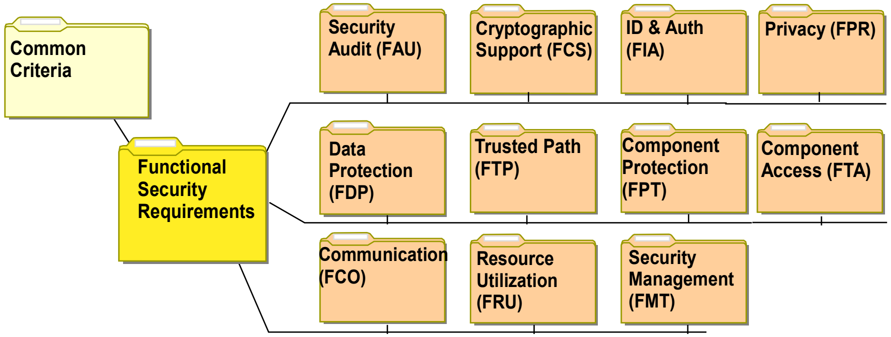
ISO/IEC 17799 Information technology – Security techniques

Code of practice for information security management

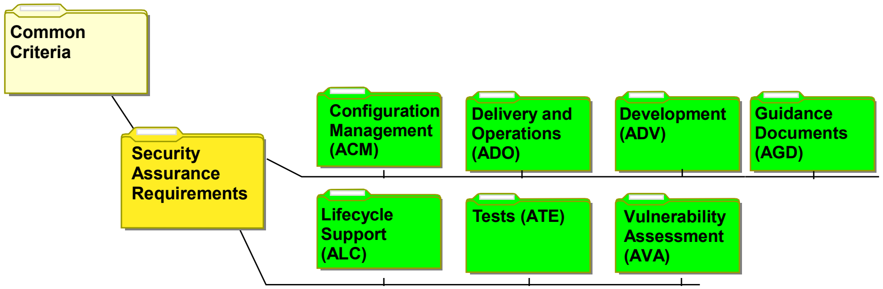

Human Resources Security
Physical and Environmental Security
Communications and Operations Management
Information Systems Acquisition, Development, and Maintenance
Asset Management
Security Policy
Organizational Information Security
System Access Control
Information Security Incident Management
Business Continuity Management
Compliance

- An Information Security Management System (ISMS) is a systematic approach to managing the security of sensitive information that encompasses people, processes, IT systems, and policy.
- The code provides recommendations which form a common basis for developing organizational security standards and effective security management practice
- Each security category contains:
  - a control objective stating what is to be achieved; and
  - one or more controls that can be applied to achieve the control objective.
- From 2007, it is proposed to incorporate the new edition of ISO/IEC 17799 into a new family of Information Security Management System (ISMS) International Standards as ISO/IEC 27002.

ISO/IEC 15408 Common Criteria includes evaluation standards for functional requirements and assurance



- Functional security requirements are grouped into 11 classes, containing over 130 components
- A Protection Profile or PP defines a standard set of requirements or 'pattern' for a particular type of system (e.g. a firewall)
- Assurance requirements are grouped into seven classes containing around 80 components
- Assurance levels define a scale for measuring the criteria for the evaluation of products and systems.
    - Evaluation Assurance Levels (EAL1-7) are constructed from the assurance components.


Common Criteria
Security Assurance Requirements
Configuration Management (ACM)
Delivery and Operations (ADO)
Development (ADV)
Guidance Documents (AGD)
Lifecycle Support (ALC)
Tests (ATE)
Vulnerability Assessment (AVA)

From a security viewpoint, a solution has two aspects which must work together to deliver end-to-end security for a business system

Application (functional) security aspect

□

□

□

□

□

Infrastructure security aspect

□

□

□

□

□

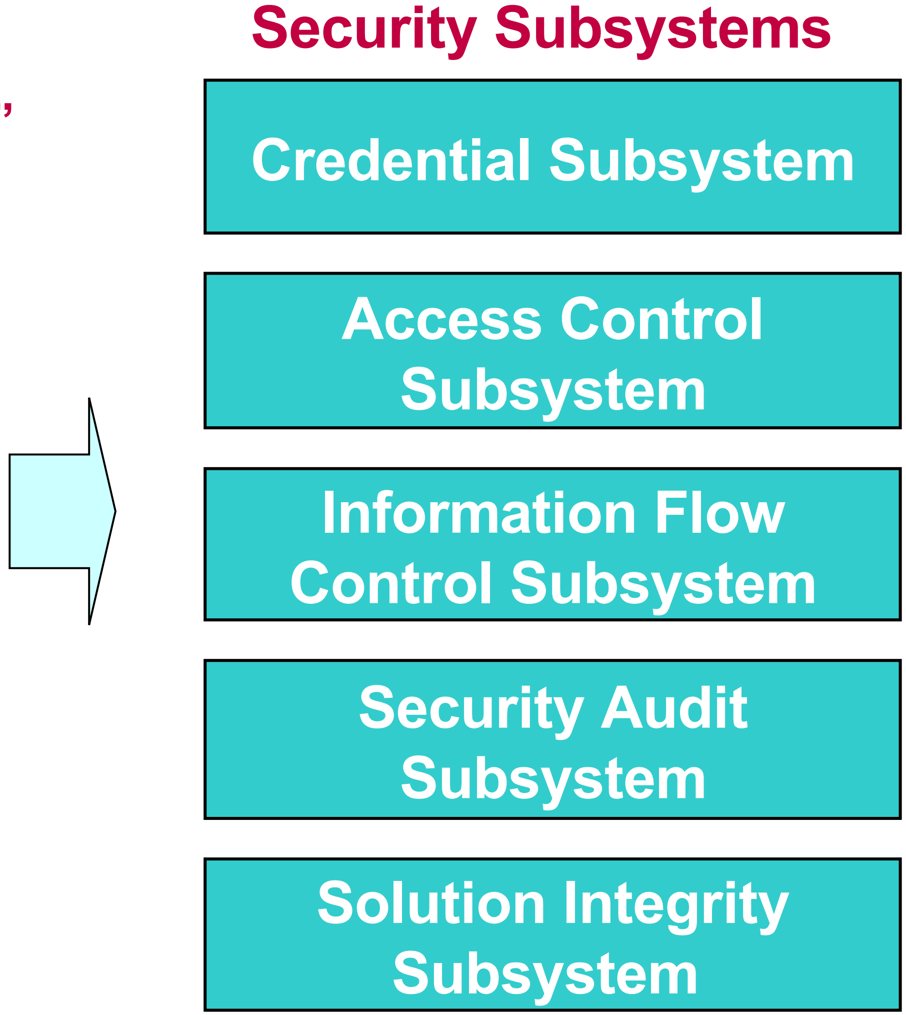
□

- These aspects are often built and maintained separately
  - For example an application hosting centre
- When a project encompasses both aspects it may be helpful to view them as separate mini-projects to maintain the clear distinction between application and infrastructure security controls

A conceptual model for security functions from a common set of security-related requirements

Identified security “Common Criteria” functional requirements classes:

- Security Audit (FAU)
- Communication (FCO)
- Cryptographic support (FCS)
- User data protection (FDP)
- Identification and authentication (FIA)
- Security management (FMT)
- Privacy (FPR)
- Protection of functions (FPT)
- Resource utilization (FRU)
- TOE access (FTA)
- Trusted path/channels (FTP)



Security Subsystems

Credential Subsystem

Access Control Subsystem

Information Flow Control Subsystem

Security Audit Subsystem

Solution Integrity Subsystem

The Security Architect's role is to show how the solution components co-operate to address security requirements

- Security requirements should be addressed *throughout* the solution – however there are also a few dedicated "security components"

Dedicated security components

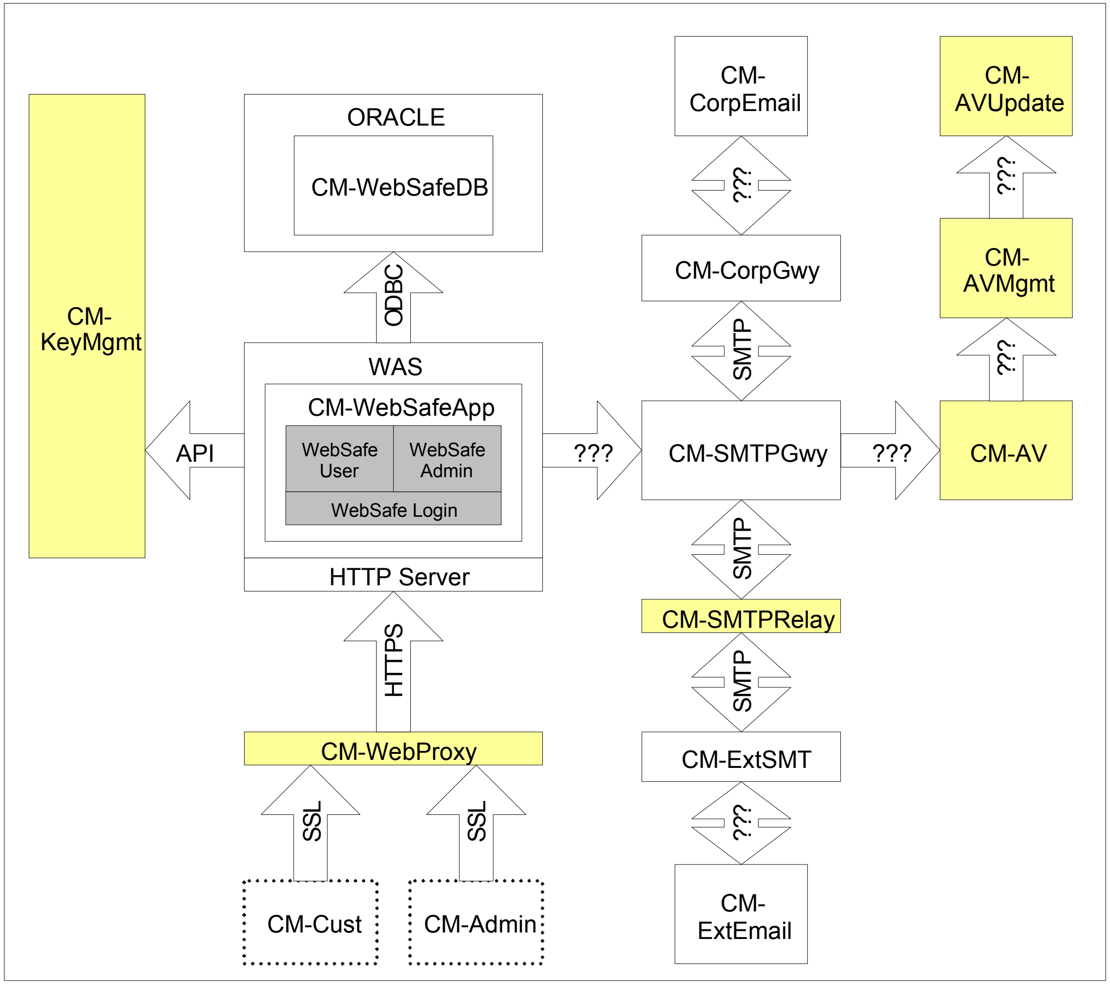
- Providing services to the components that address the business requirements

Mainstream components

- Working in conjunction with security components to implement security controls

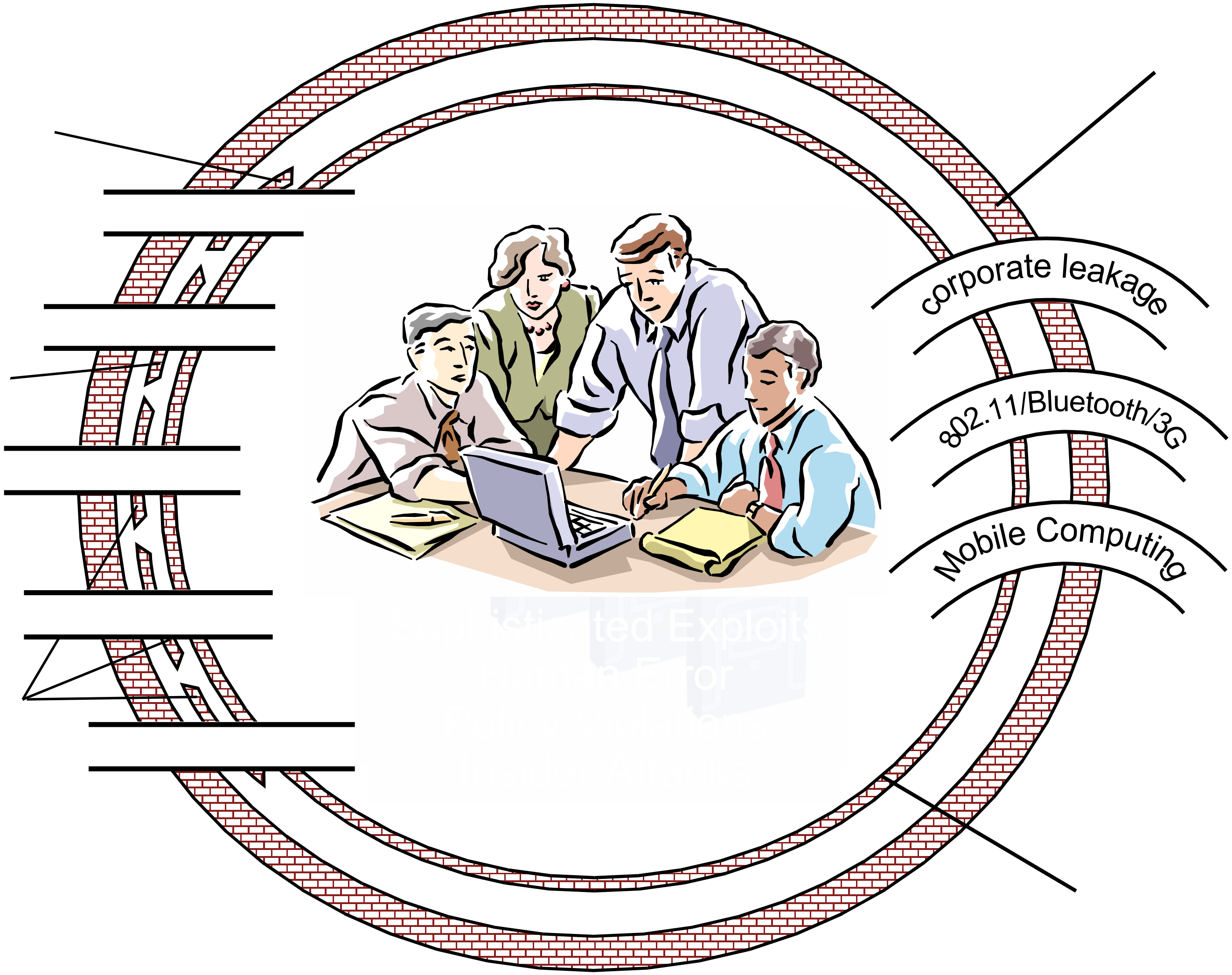
Infrastructure services

- Providing a secure, managed environment in which to run the application.



Security : Technology and Operational Architecture

Increasing expectations, range of channels and IT complexity has increased the Security challenge



In order to help us structure the infrastructure necessary to protect the enterprise, we employ the concept of Zones

Security Zones might be classified (and colour-coded) as follows:

- **Uncontrolled** – anything outside of the organisation,
  - including, but not limited to the home, street etc.
  - via a wide number of channels including, but not limited to the Internet, mobile access etc.

- **Restricted –** where access is restricted to users or systems that are trusted to some degree
  - For example, a user or system in a controlled zone

- **Controlled** – where access is limited, but users are allowed access on a controlled basis.
  - Public access to a DMZ.
  - Employee access to a corporate LAN

- **Secured –** where access is available to only a small group of highly trusted users or systems.
  - access to one secure area does not necessarily give you access to another secure area.

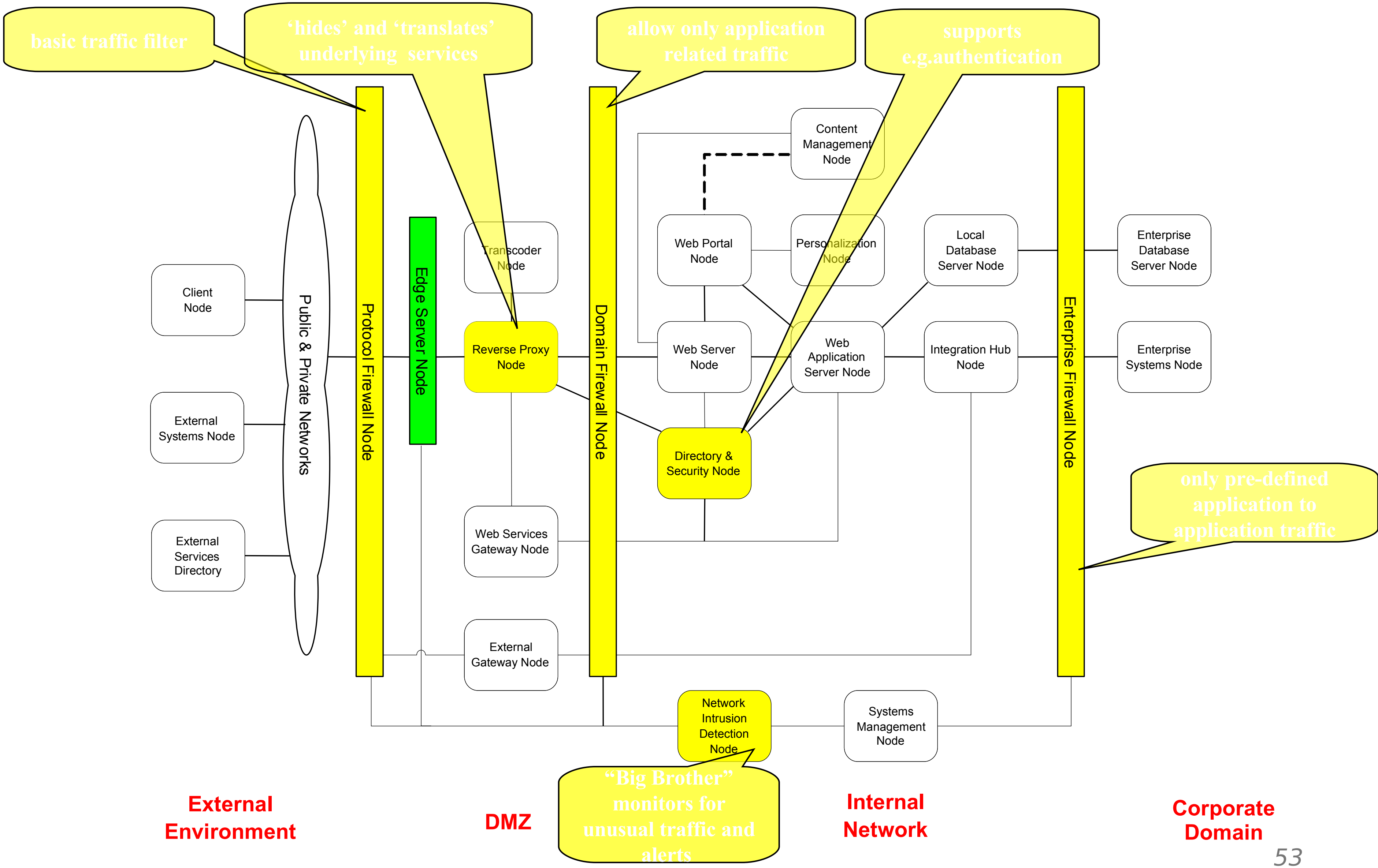
We need to elaborate the zone classification to reflect who has management control of a zone…

- Descriptors may be added to a zone classification – for example:
  - **External –** An external zone has the same characteristics as defined above,
    - control is in the hands of an external organisation *with which this organisation has a contractual relationship,*
    - The external organisation has a responsibility to operate the zone according to their own security policies.
  - This is distinct from an outsourced service provider relationship, where the security controls are operated as part of a service being provided on behalf of the Council and are consequently considered to be part of the Council’s infrastructure.

Common Security related infrastructure components

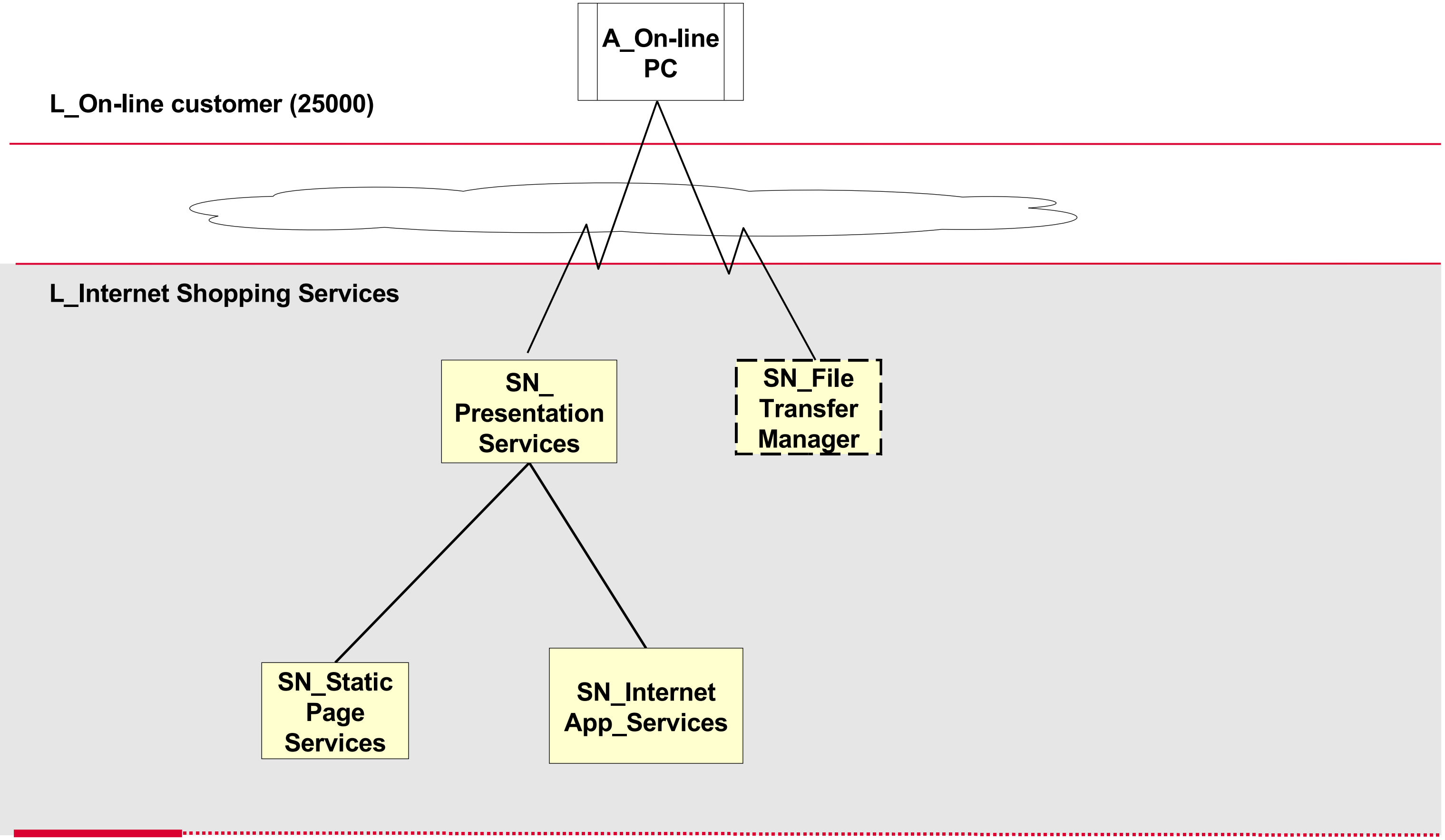
- Firewall
  - A hardware or software component which protects against unauthorised network access into or out of a particular zone
  - Firewalls aim to filter unwanted traffic out by observing packet contents and applying rules
- Security & directory servers
  - Dedicated servers hosting components managing user databases including user credential and profile data
- Intrusion detection systems
  - Components placed within the architecture with the explicit role of detecting intrusions
- Cryptographic hardware components
  - Cryptographic operations in software can be very time consuming
  - For secure systems, it is common to implement specialised hardware to perform necessary cryptographic functions quickly

Security and access related Nodes in the IBM e-Business Reference Architecture Logical Operational Model (v2.3)

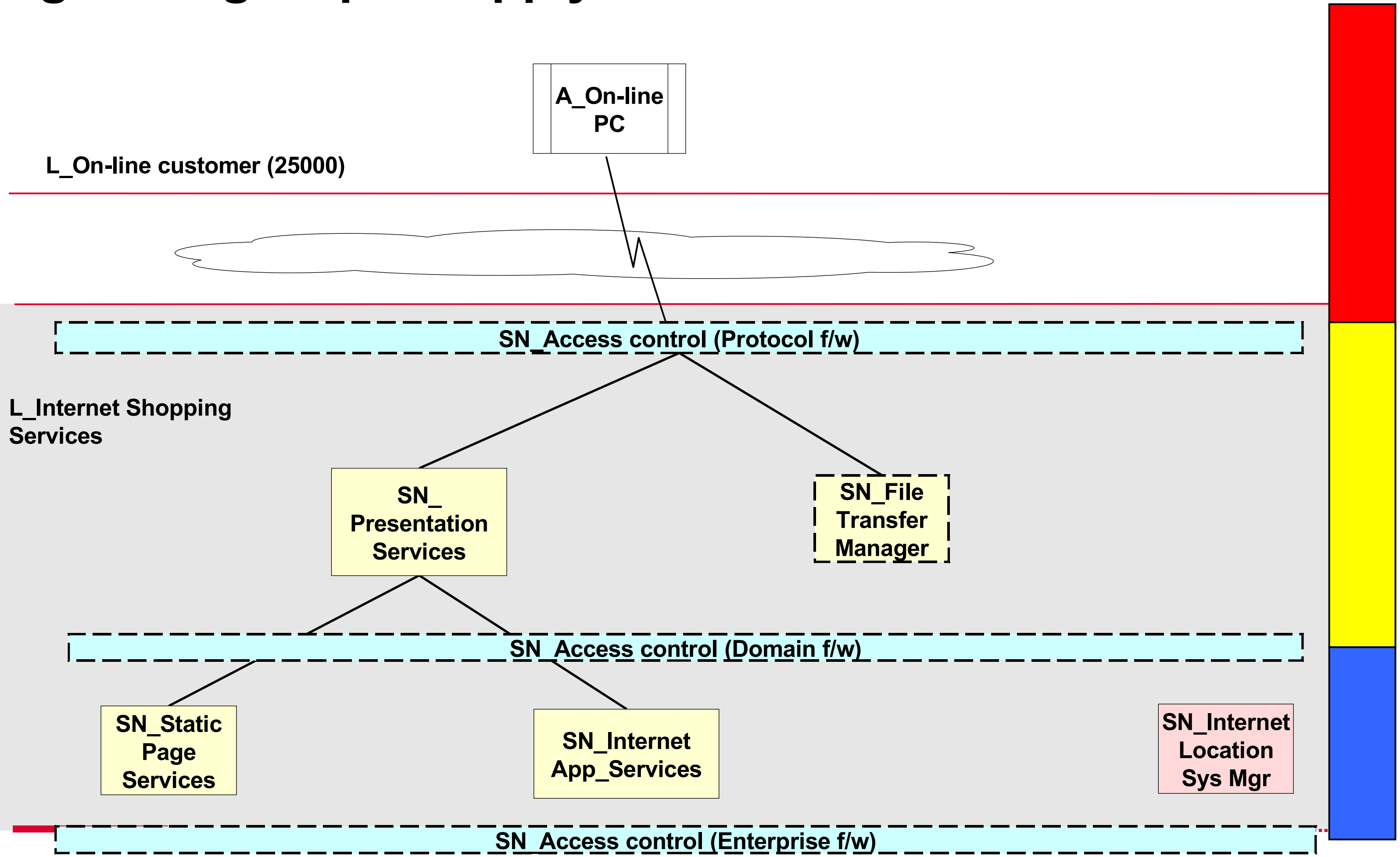

basic traffic filter
'hides' and 'translates' underlying services
allow only application related traffic
supports e.g.authentication
Content Management Node
Client Node
Public & Private Networks
Protocol Firewall Node
Edge Server Node
Transcoder Node
Web Portal Node
Personalization Node
Local Database Server Node
Enterprise Database Server Node
Reverse Proxy Node
Domain Firewall Node
Web Server Node
Web Application Server Node
Integration Hub Node
Enterprise Firewall Node
Enterprise Systems Node
External Systems Node
Directory & Security Node
only pre-defined application to application traffic
External Services Directory
Web Services Gateway Node
External Gateway Node
Network Intrusion Detection Node
Systems Management Node
"Big Brother" monitors for unusual traffic and alerts
External Environment
DMZ
Internal Network
Corporate Domain

We can use the concepts of Zones and the Reference Architecture to strengthen an Operational Model

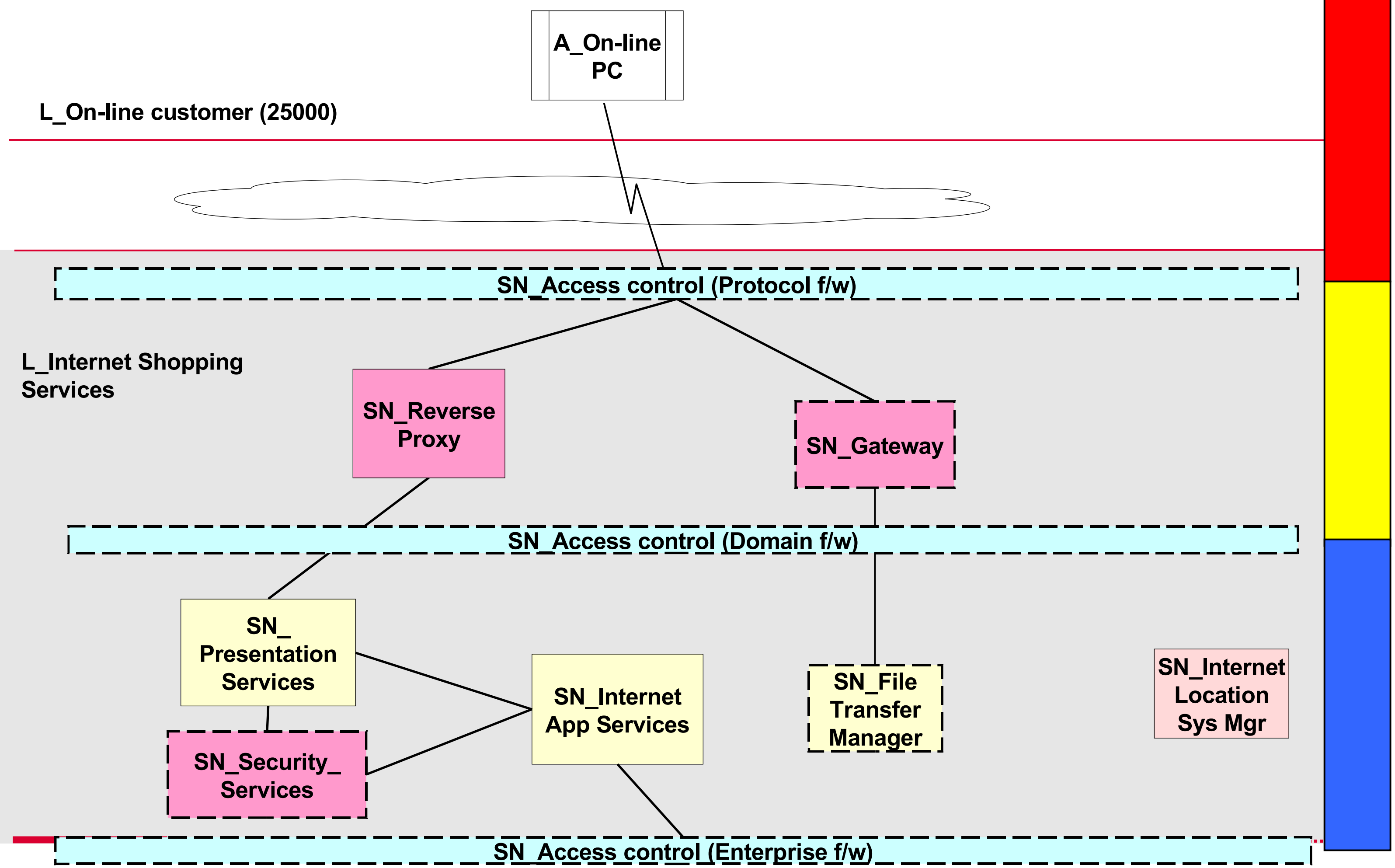
Starting point – simple (and insecure!) architecture



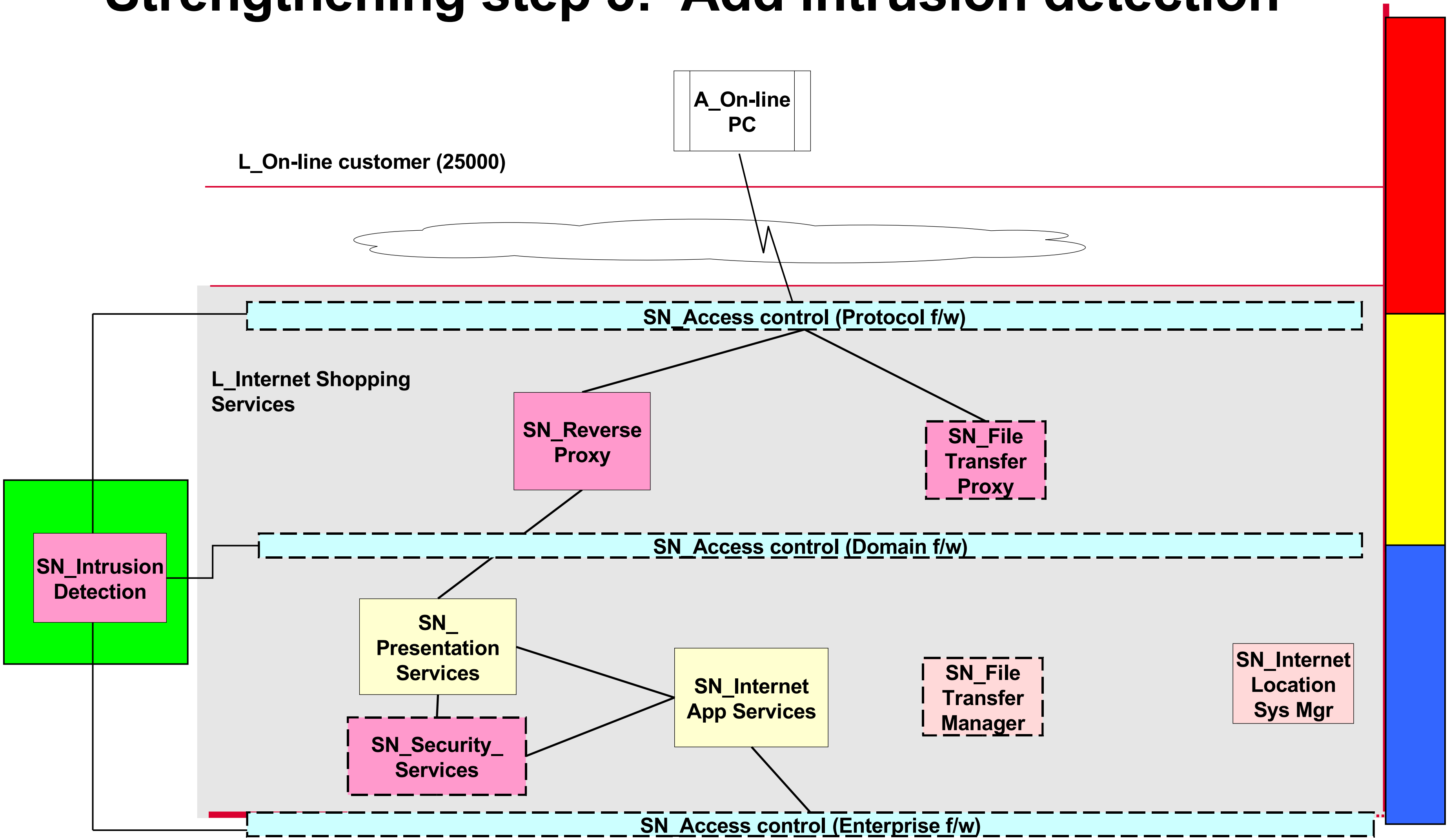
Strengthening step 1: Apply firewall and zone model


A_On-line PC
L_On-line customer (25000)
SN_Access control (Protocol f/w)
L_Internet Shopping Services
SN_ Presentation Services
SN_File Transfer Manager
SN_Access control (Domain f/w)
SN_Static Page Services
SN_Internet App_Services
SN_Internet Location Sys Mgr
SN_Access control (Enterprise f/w)

Strengthening step 2: Add security nodes and replace existing nodes

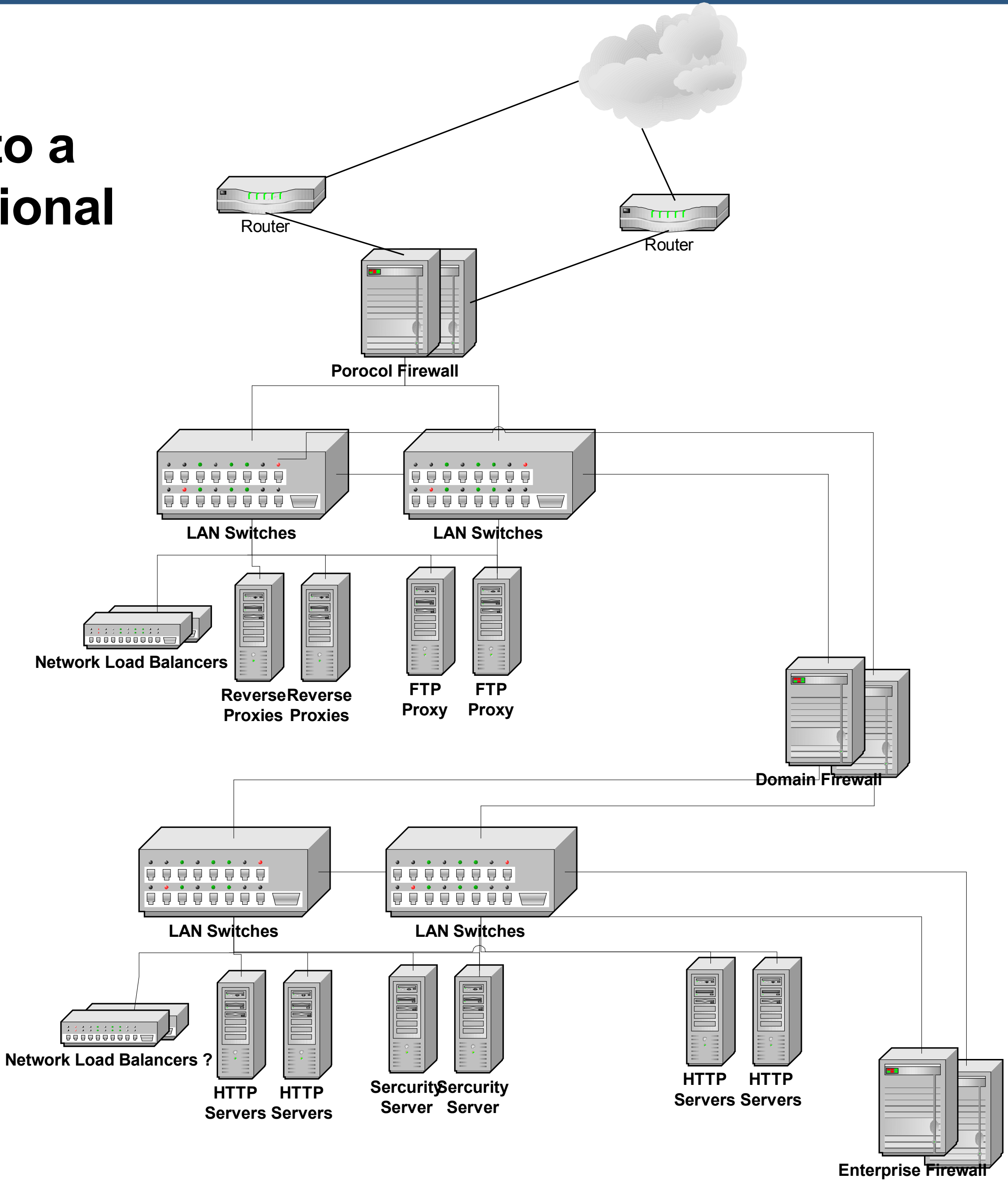

A_On-line PC
L_On-line customer (25000)
SN_Access control (Protocol f/w)
L_Internet Shopping Services
SN_Reverse Proxy
SN_Gateway
SN_Access control (Domain f/w)
SN_ Presentation Services
SN_Internet App Services
SN_File Transfer Manager
SN_Internet Location Sys Mgr
SN_Security_ Services
SN_Access control (Enterprise f/w)

Strengthening step 3: Add intrusion detection

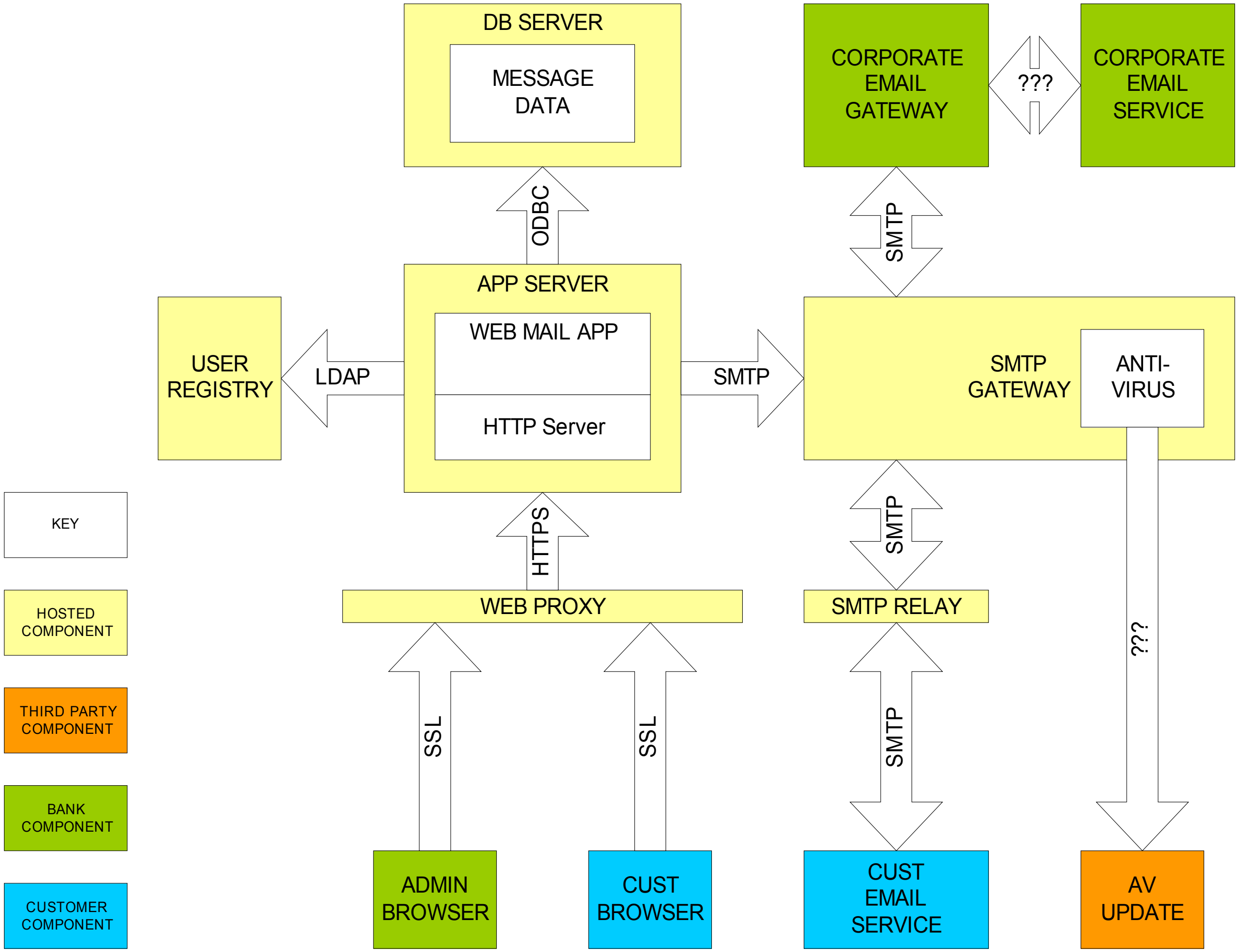

A_On-line PC
L_On-line customer (25000)
SN_Access control (Protocol f/w)
L_Internet Shopping Services
SN_Reverse Proxy
SN_File Transfer Proxy
SN_Access control (Domain f/w)
SN_Intrusion Detection
SN_ Presentation Services
SN_Internet App Services
SN_File Transfer Manager
SN_Internet Location Sys Mgr
SN_Security_ Services
SN_Access control (Enterprise f/w)

Example transformation to a Physical Operational Model

- 100Mbps LAN chosen for cost effectiveness
- Cisco 3550 Switches used for LAN infrastructure
- Cisco PIX Firewalls



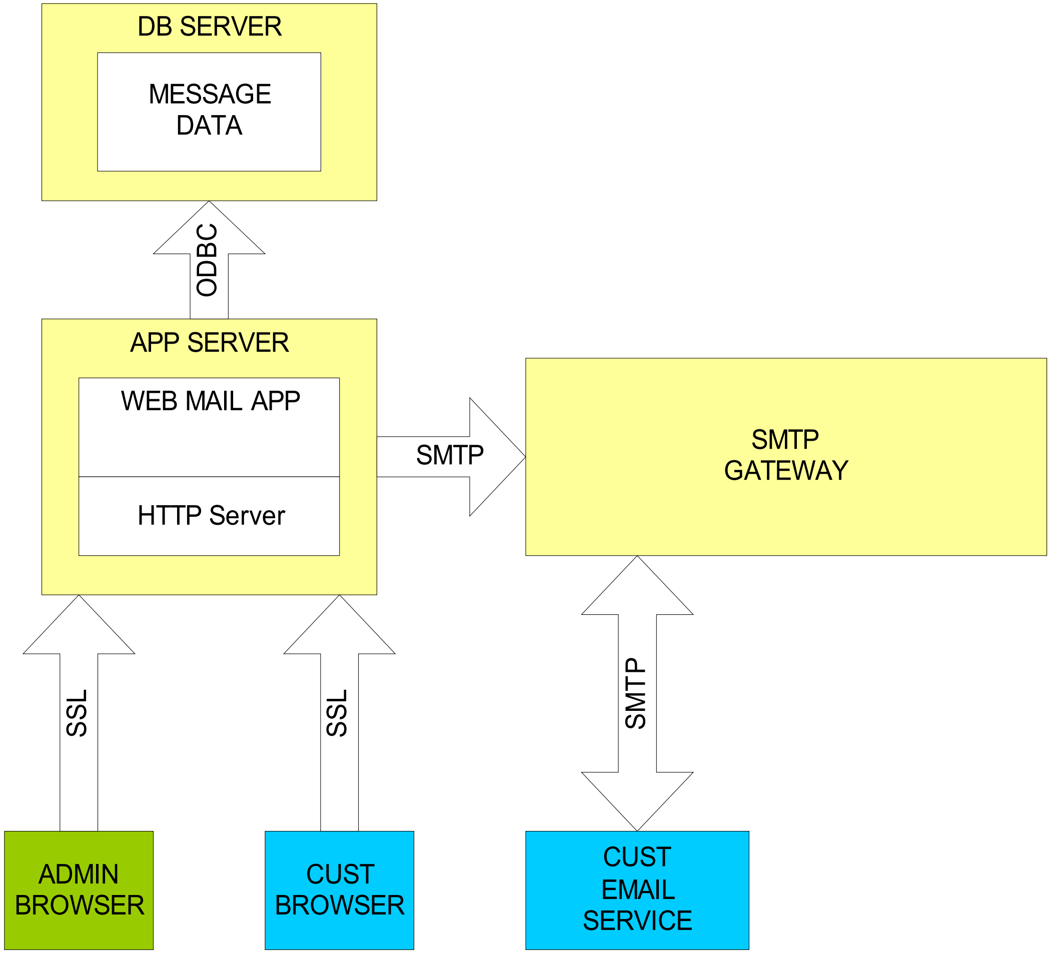
Exercise 3. In this exercise we use a logical component module for a hosted web mail service offered by a bank to its customers



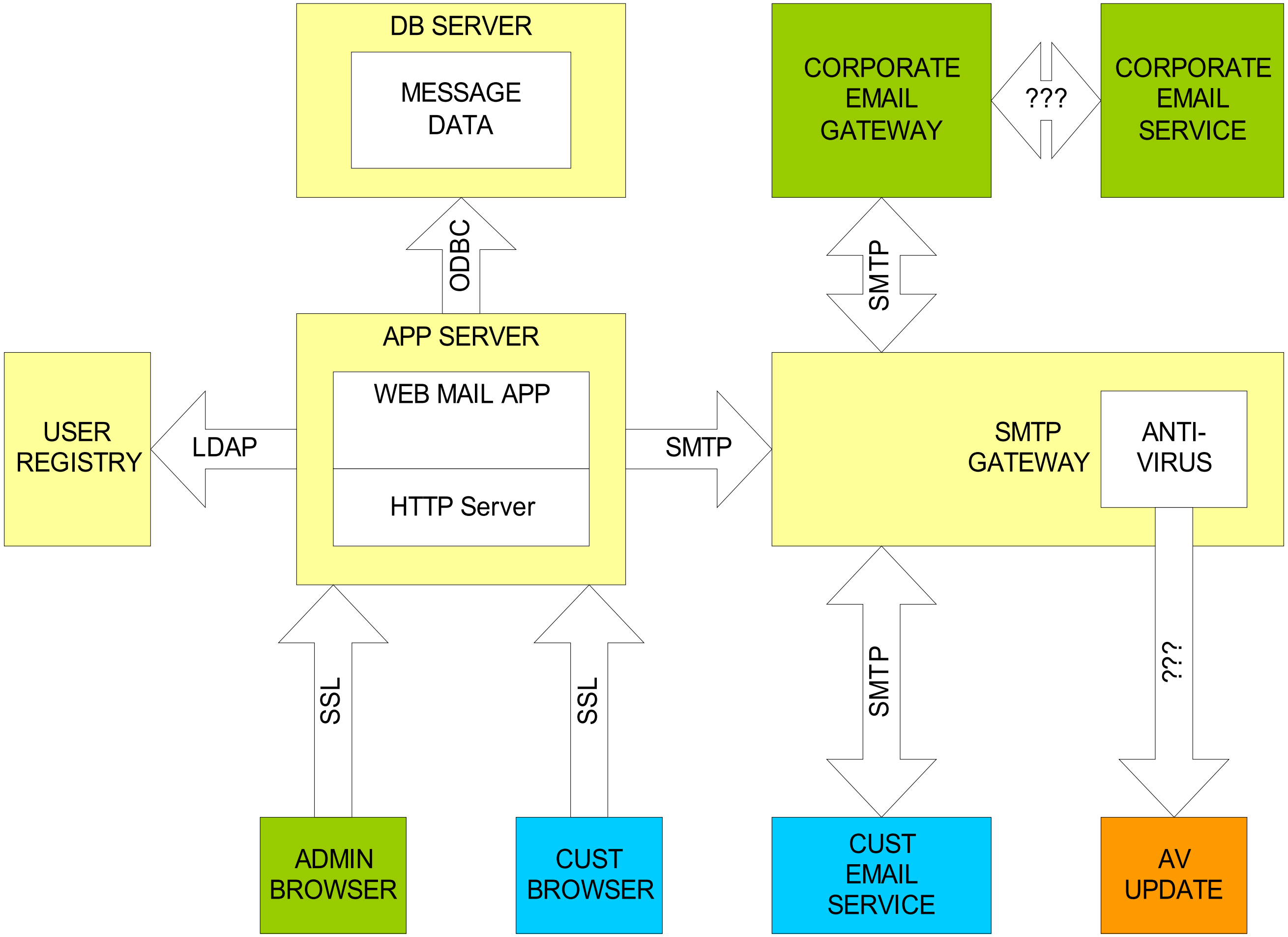
Exercise 3.1: Define a policy for flows between the different zone classifications – this is the basis for placing components

From / To	U	C	R	S
Uncontrolled				
Controlled				
Restricted				
Secure				

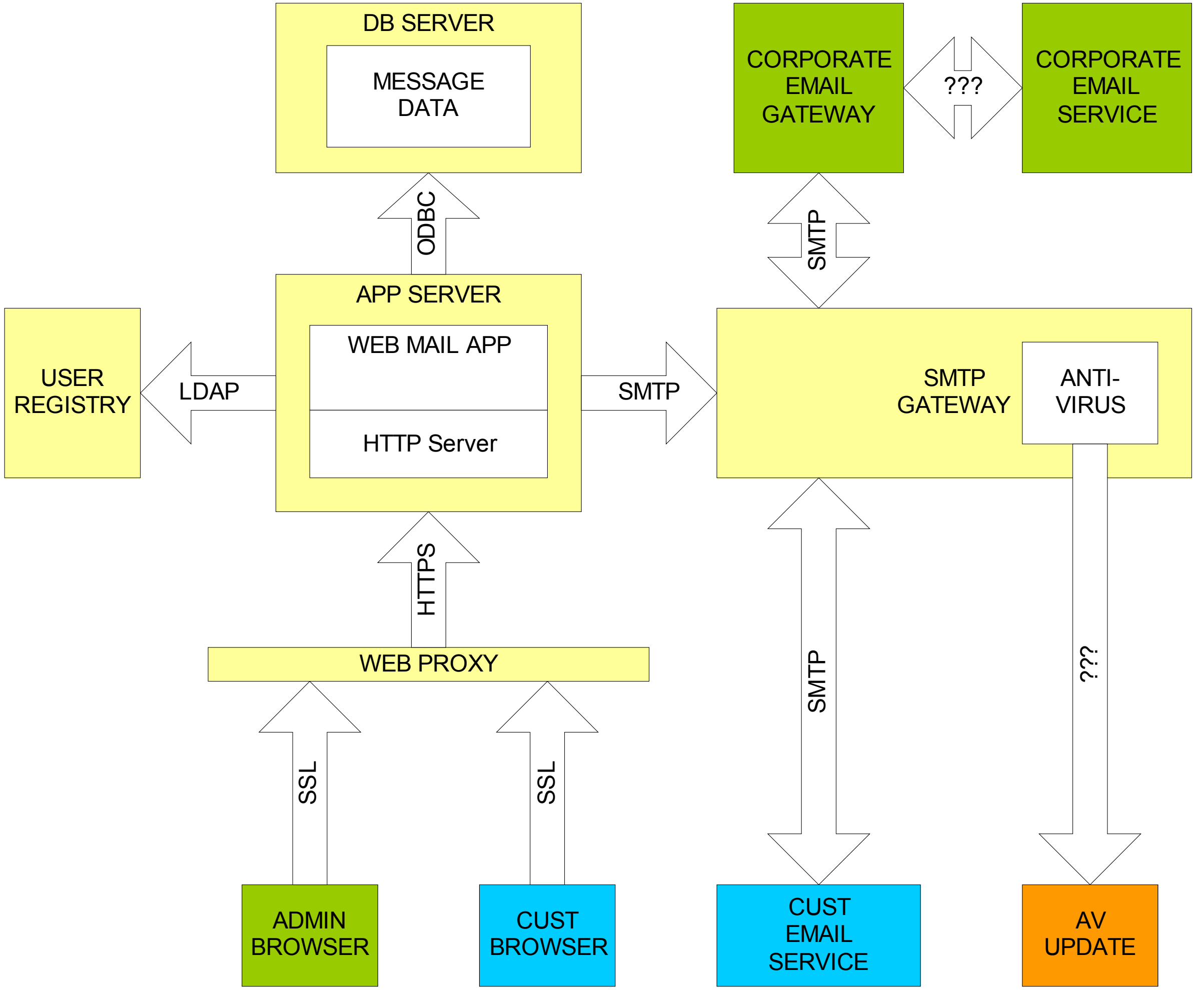
Exercise 3.2: Starting with the core application – draw some security zones onto the diagram to show how the components should be secured with a network architecture



Exercise 3.3: Now add additional security zones to address the full application function and connections – using the external designation where necessary



Exercise 3.4: How do the zones change when we add in proxy/relay servers to protect the application?

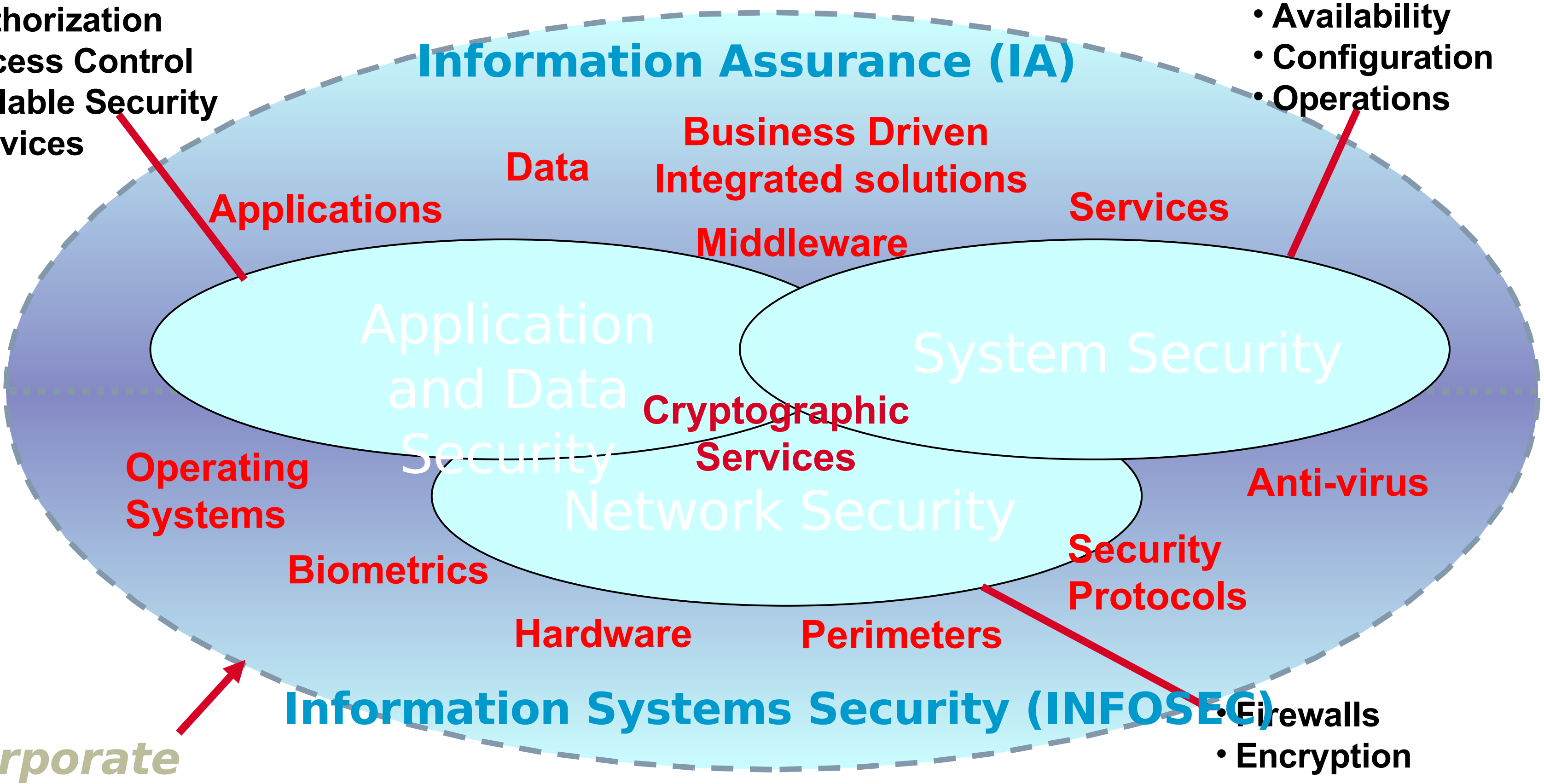


Security : Summary

The ‘big picture’ – security policy and architecture must include logical and physical protection to counteract the threats

- Authentication
- Authorization
- Access Control
- Callable Security Services

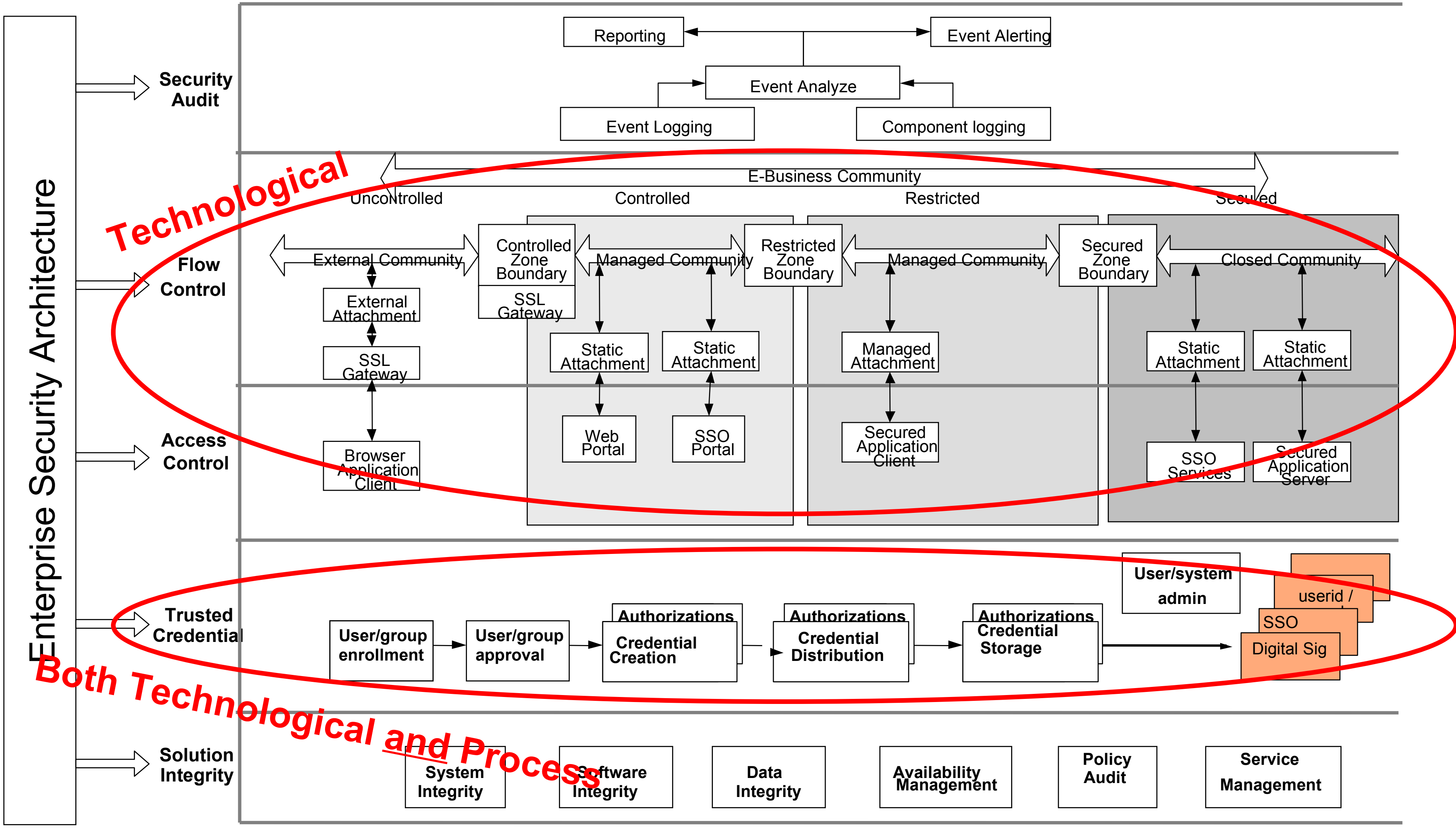
- Performance
- Availability
- Configuration
- Operations



- Firewalls
- Encryption
- Virtual Private Networks
- Intrusion Detection

Corporate Information Security Officer Perspective

In implementing the defined policy in an IT Architecture, both process and technological elements must be considered



Accessibility, Usability & People Centred Design

Accessibility, Usability and People Centred Design

- Consider:
  - Accessibility – making systems available to as wide a range of people as possible
  - Usability – making systems easy to use
- Both of these elements are complex topics in their own right, and though they have some similarities, they have a different focus
- The slides give an overview of a process that can be used – the work is specialised, but it is useful for the IT Architect to have some understanding of the challenge

Accessibility & Usability: Background and Drivers

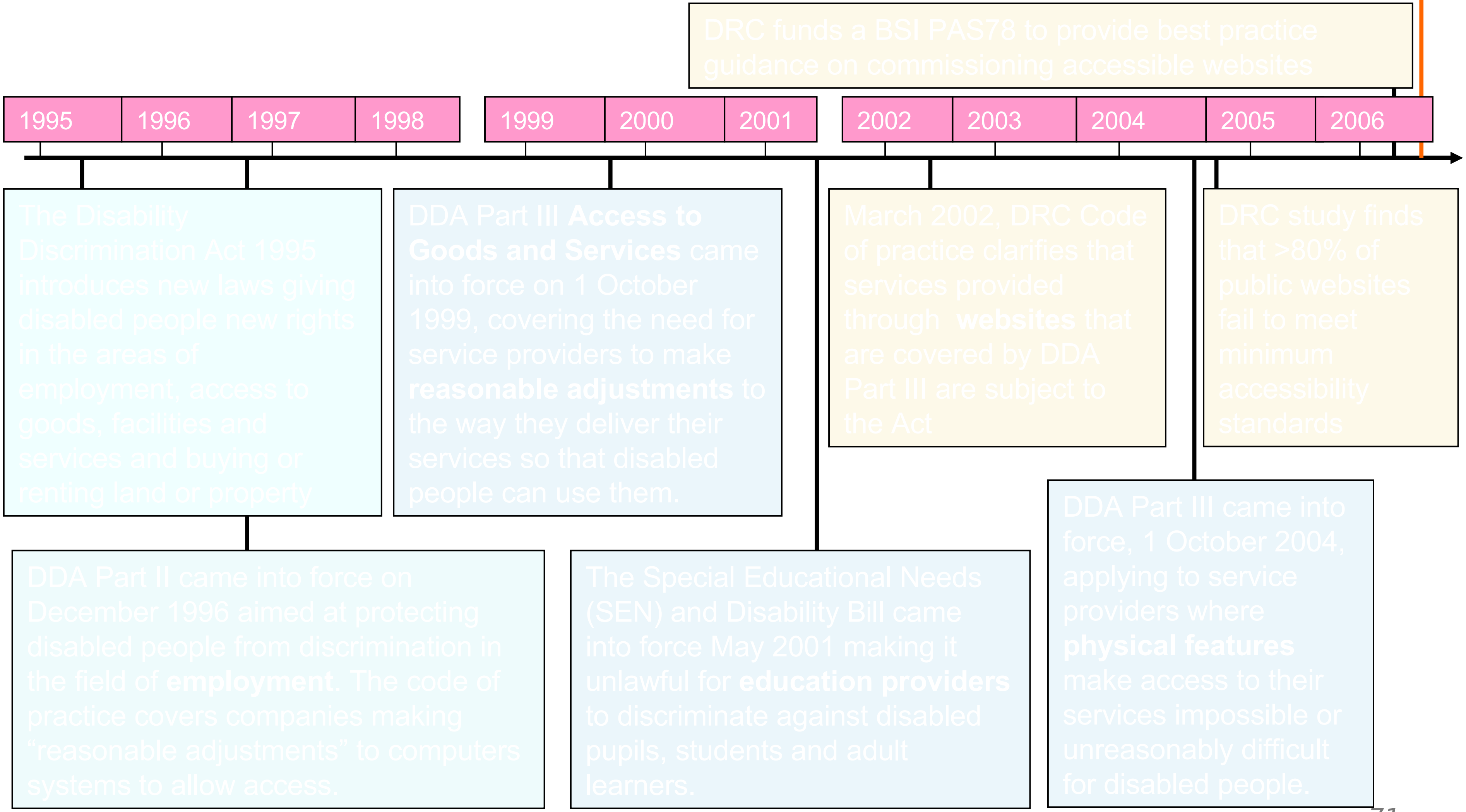
Why bother with making technology <u>accessible</u>?

The key drivers:

- **Inclusion … in the UK:**
  - Over ***10 million people*** are registered with a disability
  - Over 2 million people are blind or partially sighted
  - Over 9 million people are affected by deafness and hearing loss
  - Over 7 million people have literacy problems
  - Over 1 million have learning difficulties
- **Legislation**
  - UK The Disability Discrimination Act 1995, Part II Employment 1996, Part III Goods & services (1999), DRC Code of practice (2002), Disability Equality duty (2006)
  - The Employment Equality (Age) Regulations 2006
- **Employment**
  - Ageing workforce: *Adapting to the physiological and cognitive needs of an older workforce*
  - Labour engagement: *Lowering the skill required to use technology in the workplace*

Legislation DDA

Disability Equality duty (December 2006) Covers the duty of care of public sector organisations to include equality for disabled people in the culture of the organisation



DRC funds a BSI PAS78 to provide best practice guidance on commissioning accessible websites

The Disability Discrimination Act 1995 introduces new laws giving disabled people new rights in the areas of employment, access to goods, facilities and services and buying or renting land or property

DDA Part III **Access to Goods and Services** came into force on 1 October 1999, covering the need for service providers to make **reasonable adjustments** to the way they deliver their services so that disabled people can use them.

March 2002, DRC Code of practice clarifies that services provided through **websites** that are covered by DDA Part III are subject to the Act

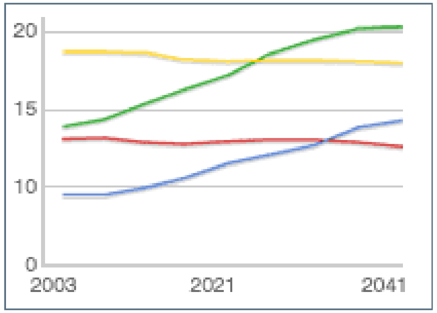
DRC study finds that >80% of public websites fail to meet minimum accessibility standards

DDA Part II came into force on December 1996 aimed at protecting disabled people from discrimination in the field of **employment**. The code of practice covers companies making “reasonable adjustments” to computers systems to allow access.

The Special Educational Needs (SEN) and Disability Bill came into force May 2001 making it unlawful for **education providers** to discriminate against disabled pupils, students and adult learners.

DDA Part III came into force, 1 October 2004, applying to service providers where **physical features** make access to their services impossible or unreasonably difficult for disabled people.

Ageing workforce



"the reality is that, as older people become an ever more significant proportion of the population, society will increasingly depend upon the contribution they can make."

Tony Blair

- By 2025, more than a third of the UK's population will be over 55.
- There is a trend of extended working life. The long term aspiration is:
  - To achieve an employment rate equivalent to 80% of the adult population, including:
    - One million **older workers** into employment
    - One million **people moving from Incapacity Benefits** into employment
- An ageing population will require accessible technologies:
  - With age, people develop new physiological and cognitive impairments.
  - With age, mild difficulties and impairments become more severe.
  - In our society, the total number of people with difficulties and impairments will increase.

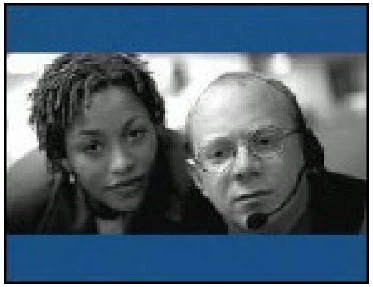
Why bother with making technology usable?

The key drivers:

- Increase sales
  - For each $1 spent on improving the visual design or style of your site, there will be virtually no improvement in sales.
  - The same $1 spent on improving core behavioral interactions with a site's critical way-finding and form-filling functions, will however, return $50-$100 if done professionally and rigorously.
  - For each $1 spent acquiring a customer, it will cost $100 to re-acquiring them after they leave because of poor usability or bad customer service.
- Reduce costs
  - The single largest predictor of call center volume is web site's usability. Calls average $22-$30 per call.
  - For every $10 spent defining and solving critical usability problems early in development using professional usability disciplines, saves about $100 in development costs.
- Other business drivers
  - Safety, efficiency, adoption, satisfaction, effectiveness, flexibility, inclusion

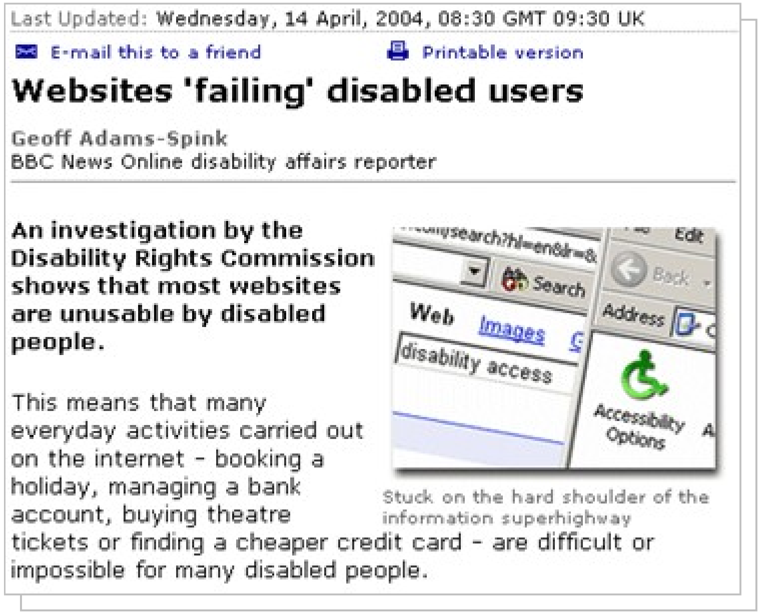
Usability is an example of a run-time quality

- Usability is defined as “the design of interactive systems used by people to satisfy personal and organisational goals.”
- Interactive systems
  - Any technology, any platform
  - Desktop, thin-client, intranet or Internet, mobile, and so on
- People
  - Any direct or indirect user of a system
  - Staff, managers, customers, citizens, learners, and so on
- Goals
  - Make money, save money, time, and lives and so on
  - Communicate, engage, persuade, retain, and so on
  - Find, buy, learn, grow, progress, and so on



Today’s picture: the majority of technology is not even technically accessible

- Only 3% of the 436 online Public Service websites in EU were considered to meet minimum accessibility standards
  Source: Cabinet Office report November 2005
- 81% of UK websites failed to satisfy basic accessibility criteria
  Source: Disability Rights Commission Study 2004



Last Updated: Wednesday, 14 April, 2004, 08:30 GMT 09:30 UK

E-mail this to a friend   Printable version

Websites 'failing' disabled users

Geoff Adams-Spink
BBC News Online disability affairs reporter

An investigation by the Disability Rights Commission shows that most websites are unusable by disabled people.

Stuck on the hard shoulder of the information superhighway

This means that many everyday activities carried out on the internet - booking a holiday, managing a bank account, buying theatre tickets or finding a cheaper credit card - are difficult or impossible for many disabled people.

> “Few designers seem to care that they are excluding millions of people from seeing or using the sites they are building”

And many interfaces have usability problems

A study from Zona Research found that:

- 62% of online shoppers gave up at least once while looking for the item they wanted
- 20% of online shoppers gave up more than three times during a two-month period
- 42% turned to traditional channels to make their purchase

A study by research group Creative Good found that:

- 39% of the customers who tested the sites for the study could not figure out how to buy
- More than 50% of search attempts failed to find something relevant.

A study cited in “Build a Site, Not A Labyrinth” (Jefferey, G.) stated that:

- 33% of online banking customers closed their accounts within a year. 50% said it was because the site was too difficult to navigate

A study by Jared Spool's found that:

- Users could only find information 42% of the time even though they were taken to the correct home page before they were given the test tasks

And some real examples of usability failures

- London Ambulance service implemented a new dispatching system. **Severe delays in ambulance arrivals** caused by technology and user interface design errors.

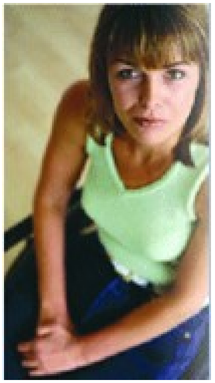
- "A financial services company had to scrap an application it had developed, when, shortly before implementation, developers doing a User Acceptance test **found a fatal flaw in their assumptions about how data would be entered**. By this time, it was too late to change the underlying structure, and **the application was never implemented."**

Some definitions…

-

- alternative adaptations

(PAS) 78



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- Interfaces are optimised

- percentages of a population can use motivated to use

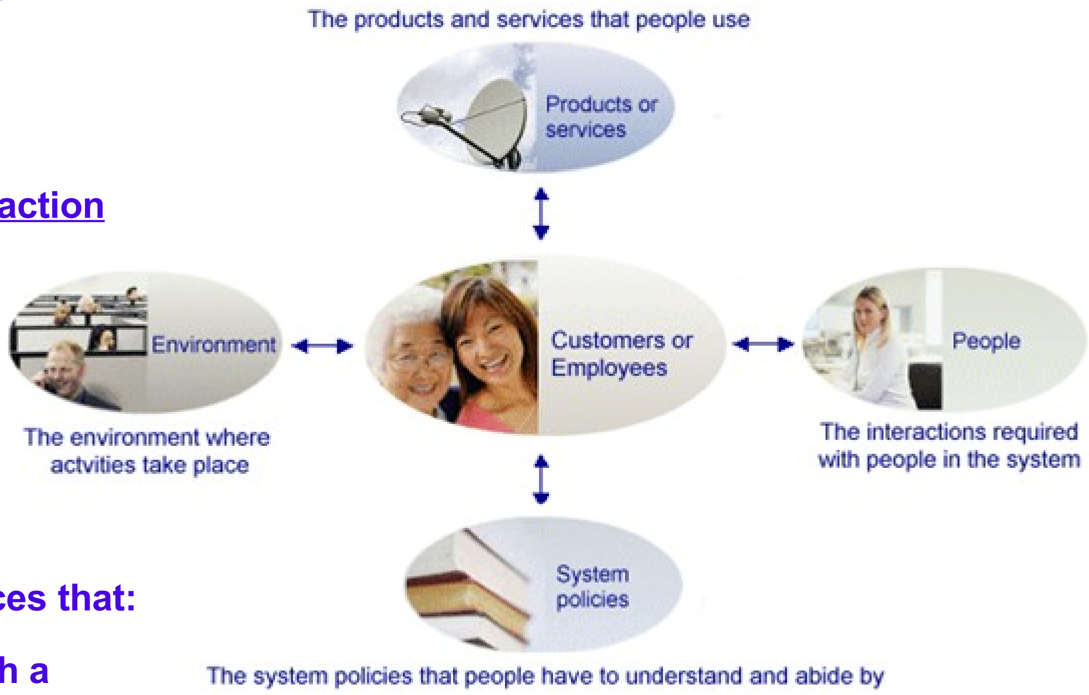
- different access mechanisms

Some more definitions…

The extent to which a product can be used:

- By specified users
- To achieve specified goals
- with effectiveness, efficiency and satisfaction
- In a specified context of use

[ISO 9241-11]


The products and services that people use
Products or services
Environment
Customers or Employees
People
The environment where actvities take place
The interactions required with people in the system
System policies
The system policies that people have to understand and abide by

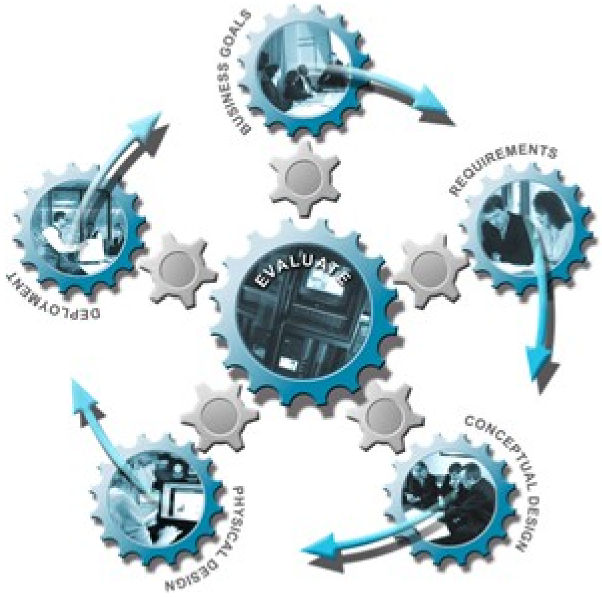
is about designing processes and interfaces that:

- Improve the way customers interact with a company
- Improve the way employees do their job
- It covers products and services, environment, system policies and human interactions

Accessibility & Usability: Method and Approach

Inclusive design relies on a rigorous process

target audiences



defined
accessibility standards

values tasks
barriers to use
access mechanisms

access,

user’s
cognitive constraints

check access

ensure targets are met

(P.S. Many standard work products exist within the IBM GS Method to help the Usability and Accessibility design processes)

- Usability
  - APP 129 Usability Requirements
  - APP 130 Use Case Model
  - APP 142 Current Solution Evaluation
  - APP 143 Early Usability Evaluation
  - APP 145 Use Case Validation Report
  - APP 146 User Interface Conceptual Model
  - APP 146 User Interface Design Guidelines
  - APP 146 User Interface Design Specifications
  - APP 146 User Interface Prototype
  - APP 146 User Profiles
- Business
  - BUS 320 Customer Needs and Wants
  - BUS 411 Business Direction
- Organization
  - ORG 017 User Support Specifications
  - ORG 153 User Support Materials
  - ORG 307 Current Organization Assessment
  - ORG 308 Human Capability Assessment

Understand the business opportunity

Understanding the business context, goals and vision for the project, such that the User Experience Design team are properly focused.

- This will include defining and prioritising:
  - Business goals:
    - E.g. Make money, save money, communicate, engage, persuade, retain, find, buy, progress…
  - Target audience:
    - E.g. Claims handlers, Supervisors
  - Measures:
    - E.g. % task success through claims process, Reduction of call centre queries about a claim
  - User experience goals
    - E.g. Efficiency, effectiveness, satisfaction. Ease of Learning, credibility, compliance ….
- And understanding
  - Current application/process/website:
    - E.g. current task support, design innovations, usability barriers
  - Current customer/employee data:
    - E.g. Customer or employee feedback, survey results, queries

What's in it for the business?

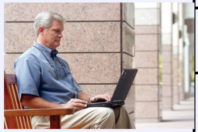
Economic	Time
	Money
	Resource
	Knowledge
	Risk
Social	Collaboration
	Communication
	Cohesion
	Privacy
Strategic	Control
	Differentiation
	Influence
	Leadership
	Perception
Subjective	Emotional
	Experiential
	Existential
	Autonomy
	Effort

Understanding users

Gathering data about the target audience is critical to success

- **Who** and **how many** need to be included in the study:
  - User profiles are created to capture
    - Target user characteristics (Age, gender, experience),
    - Social and Environmental context of use,
    - Language,
    - Usability factors (that drive the design).
    - Representative users are then invited to participate in user research studies.
- What **data** needs to be collected:
  - User researchers design the study to collect necessary data such as
    - user goals, tasks, barriers to use, terminology, classification, mental models.
- How the data will be **gathered**:
  - Study methods are selected such as
    - Field studies (ethnographic studies; contextual enquiry),
    - Workshops (short on time),
    - Focus groups (well defined audiences; easy to get),
    - Interviews (often used in combinations with another method),
    - Surveys (large statistical sample; difficult to get to see the users)

What's in it for the users?

Economic 	Time
	Money
	Resource
	Knowledge
	Risk
Social	Collaboration
	Communication
	Cohesion
	Privacy
Strategic	Control
	Differentiation
	Influence
	Leadership
	Perception
Subjective	Emotional
	Experiential
	Existential
	Autonomy
	Effort

Define and agree critical requirements

- Provides an opportunity for the User experience design team to **feedback** to the business and the technical implementation team about the the **key findings** from the stakeholder and user research studies.

- Enables the group to collectively identify any **business or technical constraints** that could impact the design direction.

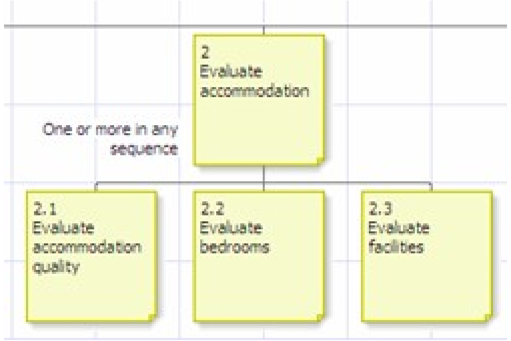
- Provides a forum to **reassess** business, design and development **priorities** as a result of the user research findings.

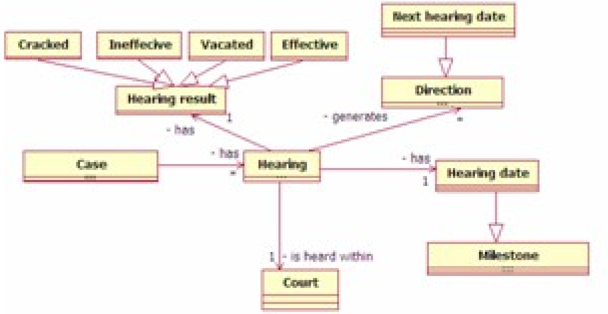
Conceptual design

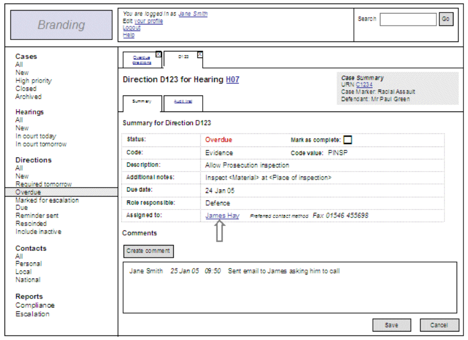
In general, 70% of usability problems are as a results of errors within the conceptual model

- Many problems relate to a poor information architecture
  - *It is not clear to users where the information is*
  - *Users are unsure of specialist terminology*

- Conceptual design involves:
  - Modelling human activity using task models
  - Modelling objects, labels and relationships using information modelling
  - State modelling is also used to capture the lifecycle of complex objects
  - Creating a wire frame to test with users
  - Reworking the design to remove usability errors






Branding

You are logged in as Jane Smith
Edit your profile
Logout
Help

Search Go

Cases
All
New
High priority
Closed
Archived

Hearings
All
New
In court today
In court tomorrow

Directions
All
New
Required tomorrow
Overdue
Marked for escalation
Due
Reminder sent
Rescinded
Include inactive

Contacts
All
Personal
Local
National

Reports
Compliance
Escalation

Overdue directions ☒ D123 ☒

Direction D123 for Hearing H07

Case Summary
URN C1234
Case Marker: Racial Assault
Defendant: Mr Paul Green

Summary | Audit trail

Summary for Direction D123

Status: Overdue Mark as complete: □
Code: Evidence Code value: PINSP
Description: Allow Prosecution inspection
Additional notes: Inspect <Material> at <Place of inspection>
Due date: 24 Jan 05
Role responsible: Defence
Assigned to: James Hay Preferred contact method Fax 01546 455698

Comments

Create comment

Jane Smith 25 Jan 05 09:50 Sent email to James asking him to call

Save Cancel

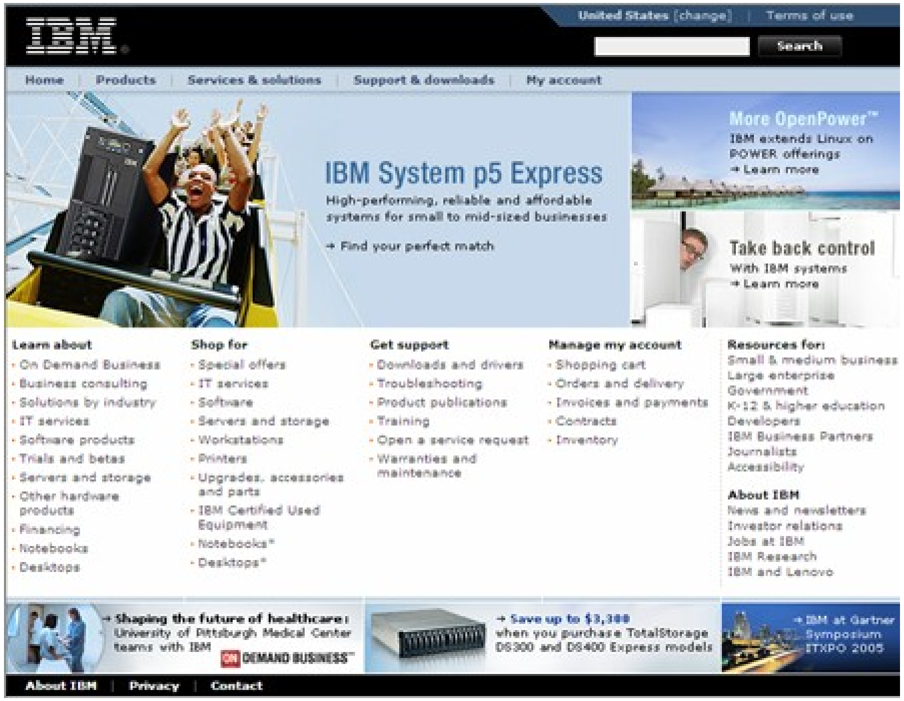
Physical design

Applies branded look and feel

- Finishes the design by defining and applying system ‘look and feel’
- Produces a user interface specification derived from the style guide
- Generates high-fidelity graphical and sometimes interactive prototypes

Documents agreed UI elements

- Ensures key elements are identified and documented as part of a style guide to
  - Protect critical assets
  - Assist future designers/developers to apply the correct design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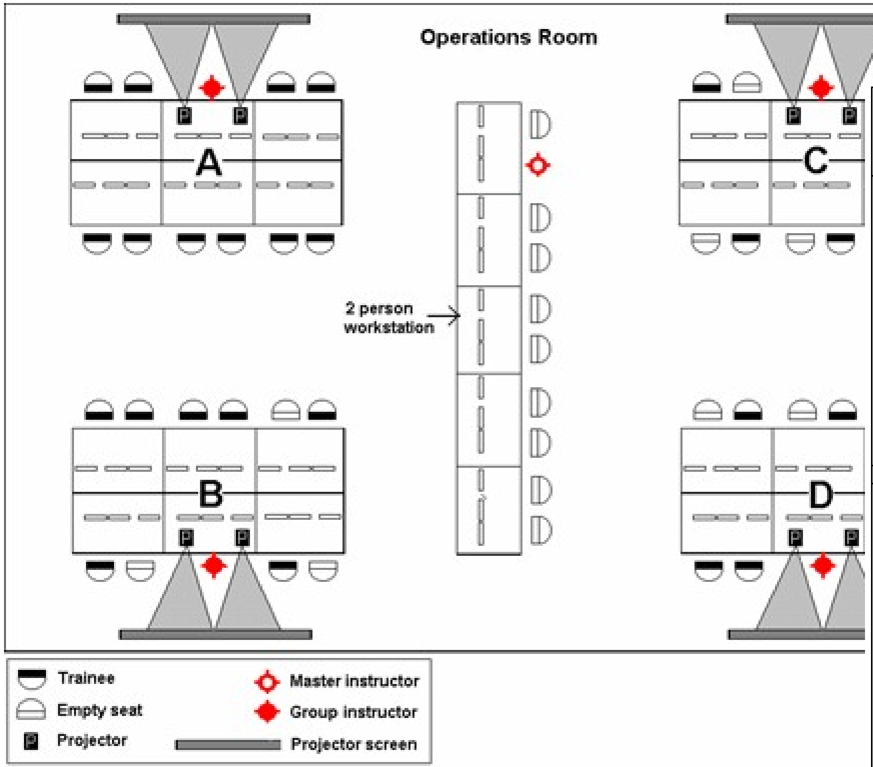
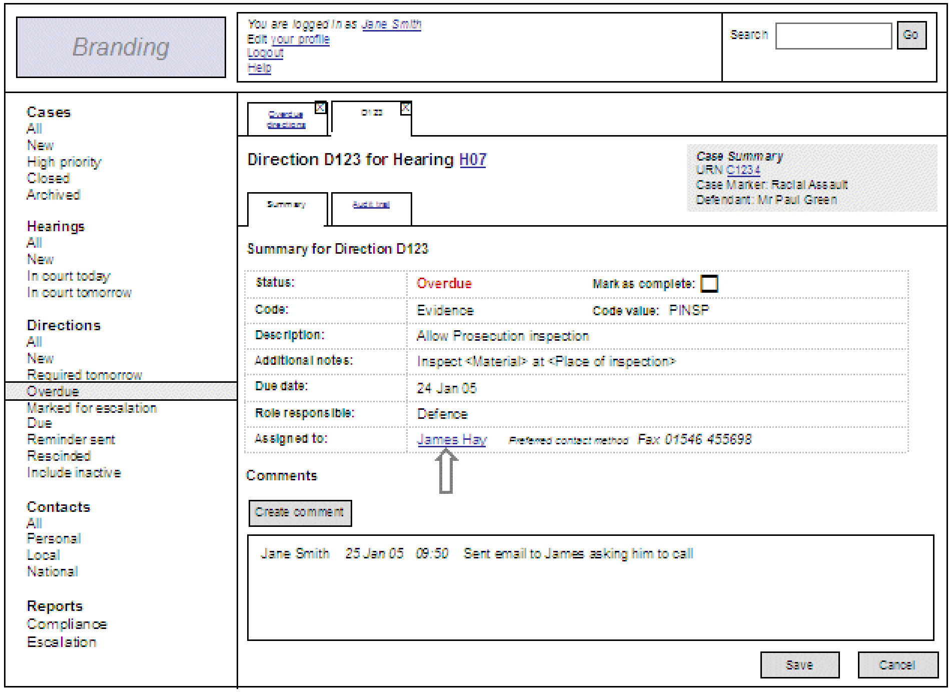
Evaluation

- Evaluation tests designs in context:
  - By observing representative users attempting typical tasks
  - By eliciting users' opinions
  - Through structured analysis by user interface specialists and ergonomists





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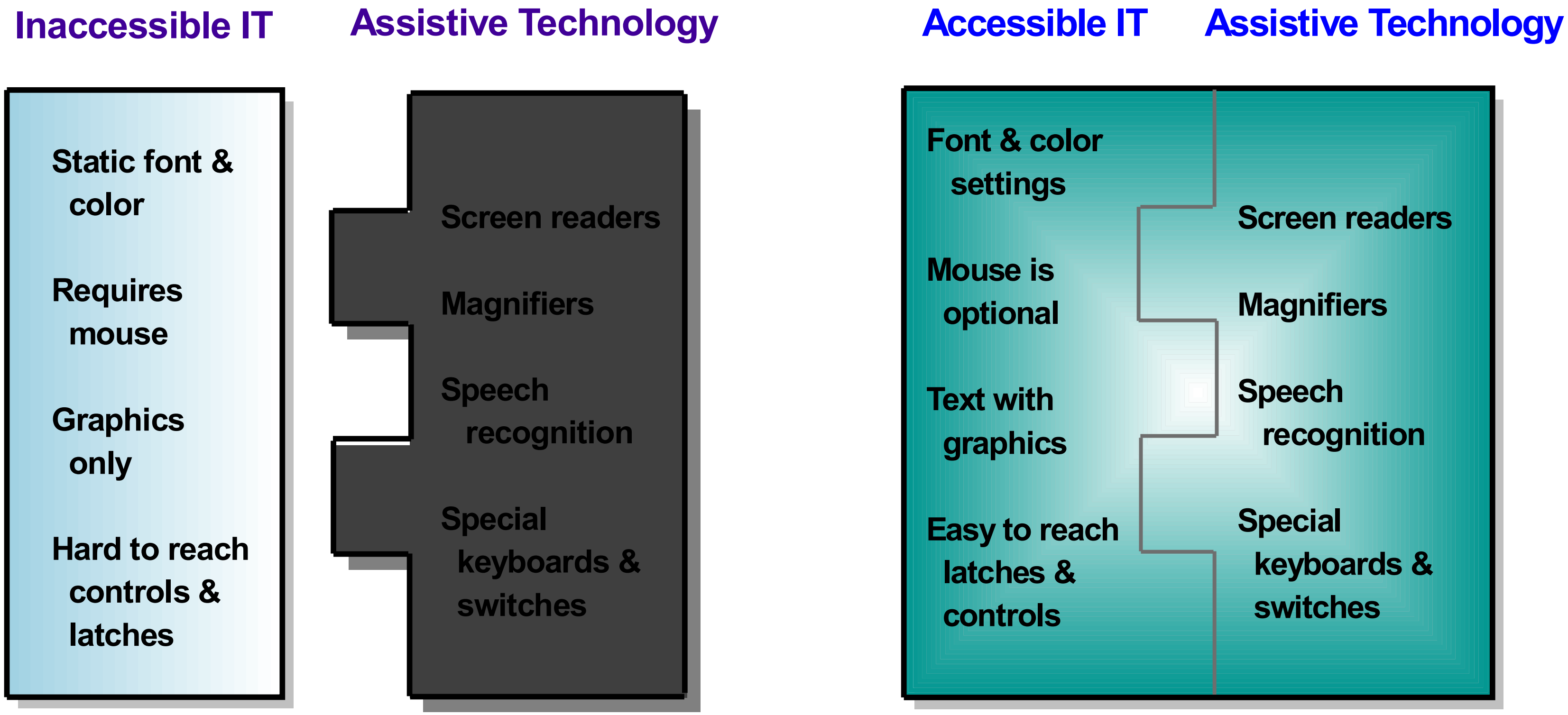
Accessibility & Usability: Solutions

"Accessibility" is both a quality and a constraint, for which however there is technology to assist us

- **Assistive Technology:** Specialised IT that allows a user with a disability to access Information Technology



Inaccessible IT

Static font & color

Requires mouse

Graphics only

Hard to reach controls & latches

Assistive Technology

Screen readers

Magnifiers

Speech recognition

Special keyboards & switches

Accessible IT

Font & color settings

Mouse is optional

Text with graphics

Easy to reach latches & controls

Assistive Technology

Screen readers

Magnifiers

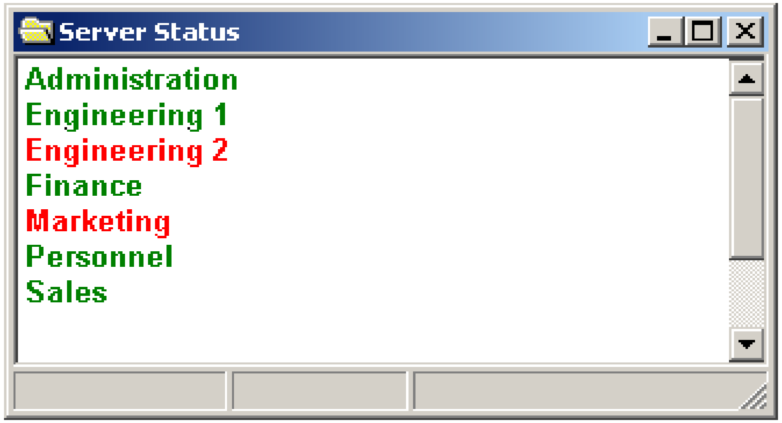
Speech recognition

Special keyboards & switches

Standards and APIs: MSAA, JAAPI, standard windows controls

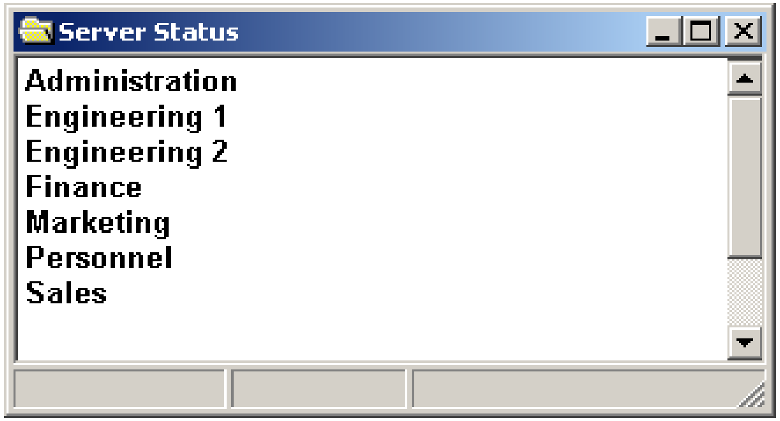
What are some examples of systems that comply with IBM and Government accessibility guidelines?

- Users with low vision need enlargeable fonts and high contrast settings.
- Users who are colour blind need more than colour differences to communicate information.
- Users who are blind must use a screen reader and the keyboard.
- Deaf users need captions and visual equivalents for audio alerts
- Hard of hearing users need to increase the volume.
- Users with limited or no use of their hands need keyboard accessibility features and alternative input methods.
- Users with attention or reading disabilities need speech synthesis, speech input, word prediction, highlighting tools, and so on.



Server Status

Administration
Engineering 1
Engineering 2
Finance
Marketing
Personnel
Sales



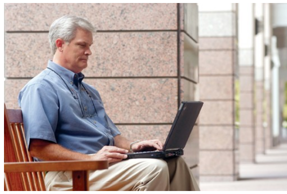
Server Status

Administration
Engineering 1
Engineering 2
Finance
Marketing
Personnel
Sales

Accessibility tools

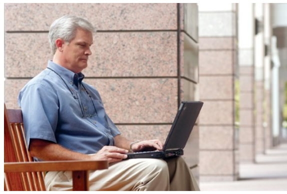
Disability *Assistive technologies can help many people with physiological disabilities*		Example Assistive technologies
Vision	Includes: ⁙ people who have a registered disability such as those who are blind, or have limited vision ⁙ people who are not registered but still have a visual impairment such as colour blindness	Screen readers Magnification software Braille displays and printers Visual adaptation software (WAT)
Hearing	Includes: ⁙ people who have developed audio impairments over time, with some level of hearing loss to those who are now deaf ⁙ people who were born deaf and where English is their second language	Captioning software Universal messaging Signing avatars
Dexterity	Includes: ⁙ people with a registered disability such as those who have lost limbs, and those with conditions such cerebral palsy and spinal cord injuries ⁙ people who may be temporarily disabled, for example people recovering from injuries that affect their ability to use computers	Mouse smoothing software Speech recognition software Eye tracking software Head sticks Sticky keys (OS settings) Alternative mice and keyboards

Inclusive design can help with some cognitive impairments



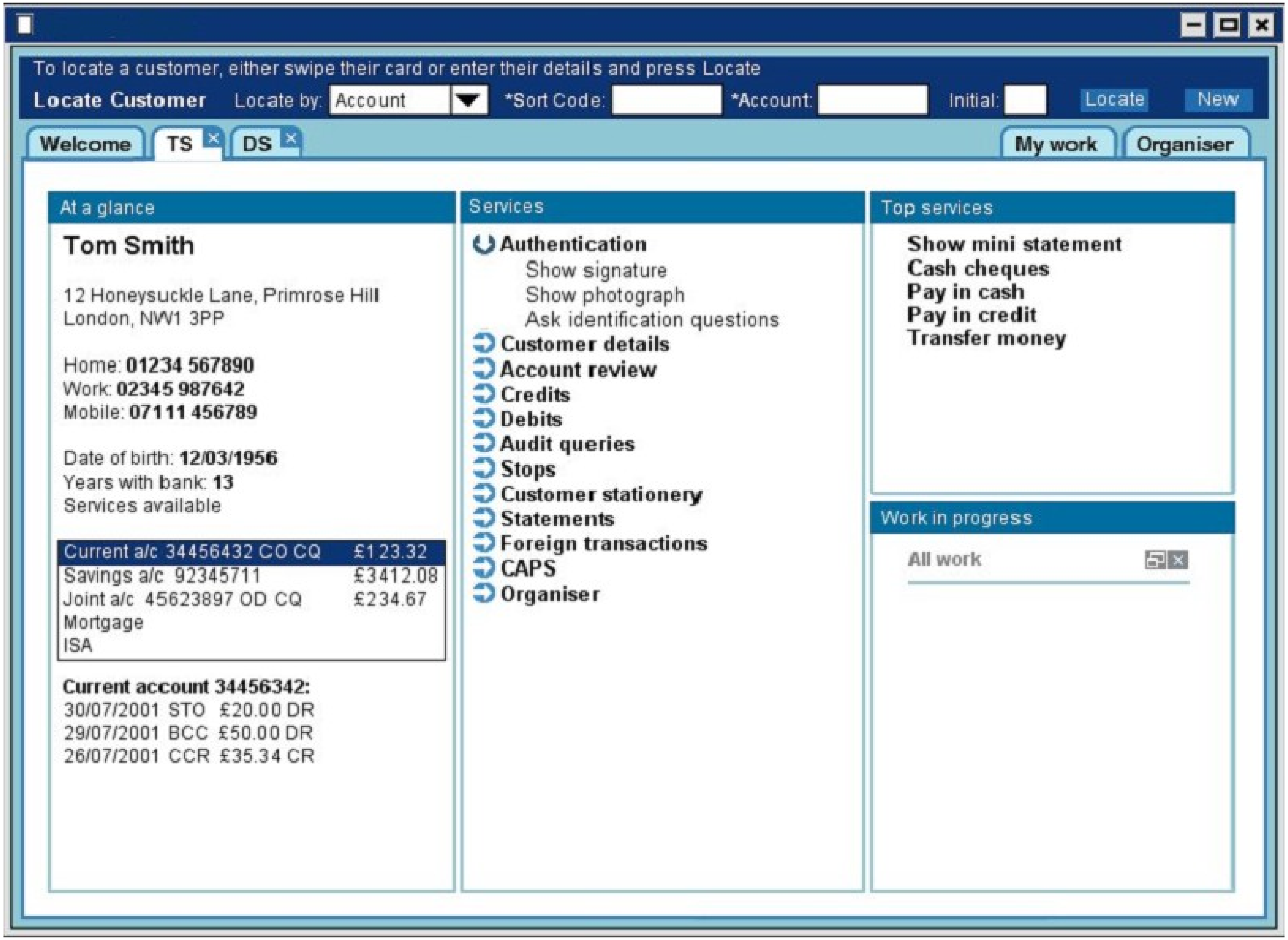
Cognitive impairment		Design approaches
Intelligence *Defined as the ability to solve problems through reasoning and experience*	Includes: ▪ People whose ability to complete tasks is compromised by a lack of understanding and reasoning.	Design for ease of learning, simplified task models, structured and consistent use of concepts and language
Memory *Defined as the ability to encode, store and recall information*	Includes: ▪ People who have difficulty learning new concepts and terminology ▪ People who have difficulty completing tasks that rely on remembering names, objects and processes	Design to reduce memory load, information in context, persistent data, feedback on progress and actions, consistent concepts and language
Attention *Defined as the ability to concentrate on one thing whilst ignoring others*	Includes: ▪ People who have difficulty reading instructions and are distracted when completing tasks resulting in careless mistakes	Design for efficiency and Appeal. Reduce task completion time and increase the use of novel methods to convey familiar concepts. Defensive design.
Perception *Defined as the ability to acquire, interpret, select and organise information*	Includes: ▪ People who have difficulty understanding and interpreting textual, visual or numerical data, for example people with dyslexia and dyscalculia	Designs can be optimized for good information and visual design, symbology and clear writing style (Easy to read)

Inclusive design can help with some adoption issues



Common barriers to technology adoption		Is affected by
Motivation	Where people do not perceive sufficient or indeed any value in the system to invest the effort in learning something new.	**Poor research and communication of user goals and value models**
Confidence	Where people are not confident in their ability to make the right decision or to complete tasks without error. Confidence may be related to a previous bad experience or an inability to accurately remember data required by a system.	Poor information architectures, complex language and task models, **technology mismatch**
Knowledge and learning	Where people do not believe they have sufficient domain or computing experience to use the system effectively. Where people perceive that the system will require an inappropriate amount of time to learn	Unfamiliar concepts, language and metaphors
Trust	Where people may not trust the organization and therefore the services provided by the organization. Issues may include data security, communication ethics, level and quality of service.	Poor craftsmanship, communication and writing style
Autonomy	Where people perceive an inappropriate level of control and influence is being exerted by the system	Inflexible interaction styles, mismatch with user's conceptual model
Privacy	Where people perceive an inappropriate intimacy as a result of intrusive questioning or persistent communication.	Conflicting business goals, poor user value communication

An Example Interface from a Large UK Retail Bank



To locate a customer, either swipe their card or enter their details and press Locate

Locate Customer Locate by: Account ▼ *Sort Code: *Account: Initial: Locate New

At a glance

Tom Smith

12 Honeysuckle Lane, Primrose Hill
London, NW1 3PP

Home: **01234 567890**
Work: **02345 987642**
Mobile: **07111 456789**

Date of birth: **12/03/1956**
Years with bank: **13**
Services available

Current a/c 34456432 CO CQ	£123.32
Savings a/c 92345711	£3412.08
Joint a/c 45623897 OD CQ	£234.67
Mortgage	
ISA	

Current account 34456342:
30/07/2001 STO £20.00 DR
29/07/2001 BCC £50.00 DR
26/07/2001 CCR £35.34 CR

Services

- **Authentication**
  - Show signature
  - Show photograph
  - Ask identification questions
- **Customer details**
- **Account review**
- **Credits**
- **Debits**
- **Audit queries**
- **Stops**
- **Customer stationery**
- **Statements**
- **Foreign transactions**
- **CAPS**
- **Organiser**

Top services

Show mini statement
Cash cheques
Pay in cash
Pay in credit
Transfer money

Work in progress

All work

Summary: how do Usability and Accessibility themes impact our requirements, solutions and testing plans?

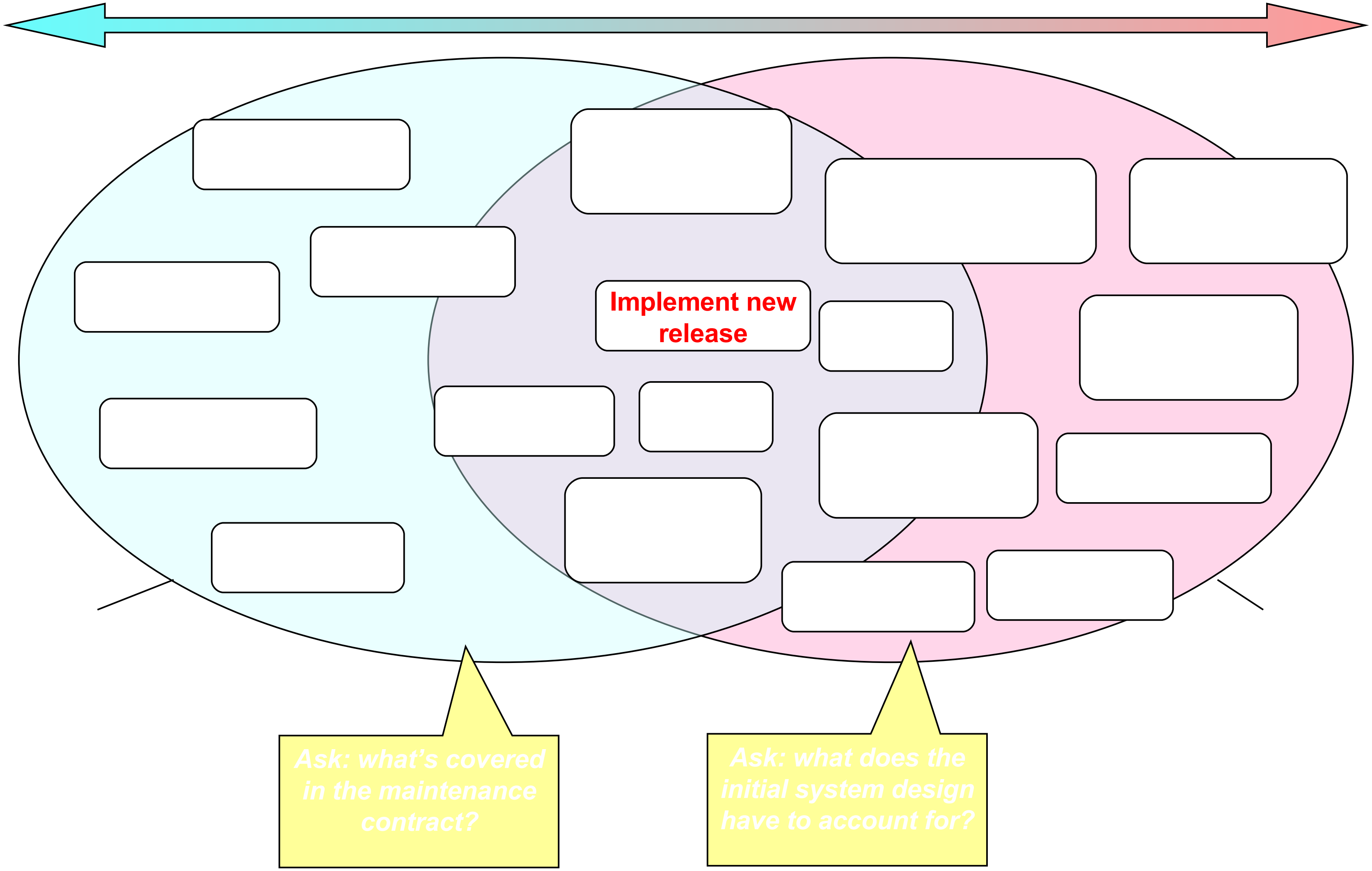
Area	Impact	Examples
Requirements	Include Usability & Accessibility Goals and standards	• "Delivered systems must meet DDA guidelines"
Functional & Content Model	Include components which are required to delivery Usability & Accessibility requirements Design components to meet restrictions implied by requirements	• Transcoding components for different device formats • Limit front end UI to HTML only (no custom applets, etc.)
Operational Model	Infrastructure nodes and deployment design to support accessibility and usability oriented components	• Transcoding node (performance critical) • Client-side deployment of assistive technologies
Implementation & Testing	Ensure additional time is budgeted for to create and test content delivery alternatives Test plans and environment must include appropriate elements	• User acceptance test must include usability & accessibility phase and test cases

Maintainability & Flexibility in IT Systems

Definitions of two related but identifiably different things

- Maintainability:
  - The degree to which a delivered system can be (cost-effectively) maintained in live operations whilst still meeting all business objectives
  - Includes the capacity to apply fixes safely, alter functionality in live, upgrade software, etc.
- Flexibility:
  - The degree to which a system can be changed or extended to meet new or altered business requirements with minimum cost, effort and impact to operations
  - Includes the capacity to change or extend functionality, repurpose for different needs, or scale to different volumes and usage scenarios

Overlap of Maintainability & Flexibility objectives



Ask: what’s covered in the maintenance contract?

Ask: what does the initial system design have to account for?

Method Work Product – the Change Case

7.

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Changes are relevant and deserve to be included if they affect the architecture and design now.

•

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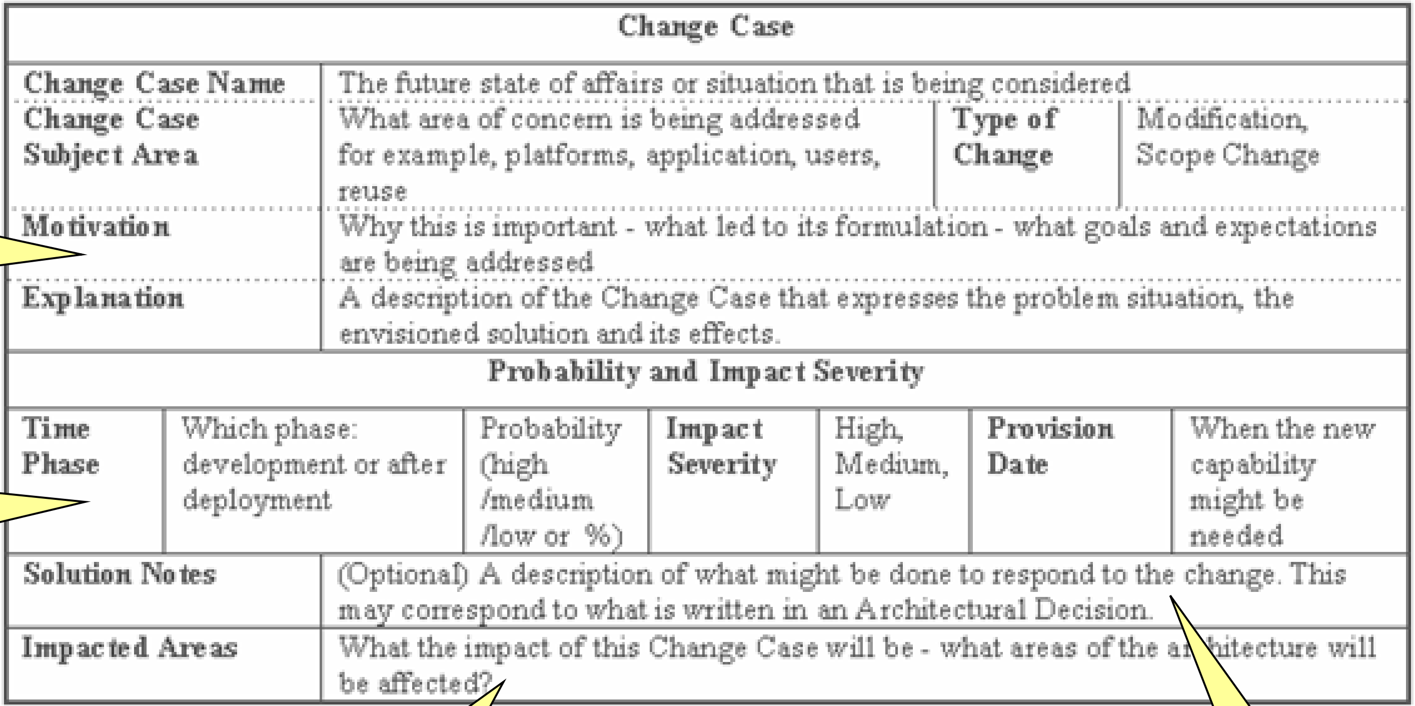
•

•

•

Change Case Template



<table>
<tr><th colspan="7">Change Case</th></tr>
<tr><td>Change Case Name</td><td colspan="6">The future state of affairs or situation that is being considered</td></tr>
<tr><td>Change Case Subject Area</td><td colspan="4">What area of concern is being addressed for example, platforms, application, users, reuse</td><td>Type of Change</td><td>Modification, Scope Change</td></tr>
<tr><td>Motivation</td><td colspan="6">Why this is important - what led to its formulation - what goals and expectations are being addressed</td></tr>
<tr><td>Explanation</td><td colspan="6">A description of the Change Case that expresses the problem situation, the envisioned solution and its effects.</td></tr>
<tr><th colspan="7">Probability and Impact Severity</th></tr>
<tr><td>Time Phase</td><td>Which phase: development or after deployment</td><td>Probability (high /medium /low or %)</td><td>Impact Severity</td><td>High, Medium, Low</td><td>Provision Date</td><td>When the new capability might be needed</td></tr>
<tr><td>Solution Notes</td><td colspan="6">(Optional) A description of what might be done to respond to the change. This may correspond to what is written in an Architectural Decision.</td></tr>
<tr><td>Impacted Areas</td><td colspan="6">What the impact of this Change Case will be - what areas of the architecture will be affected?</td></tr>
</table>

What is the change motivated by?

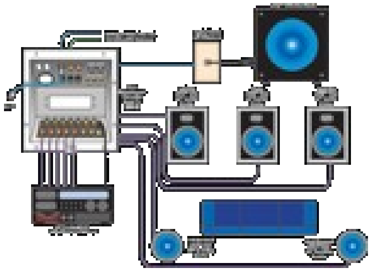
When is it likely to occur?

What are the implications and impacts of the change?

What will the solution be?

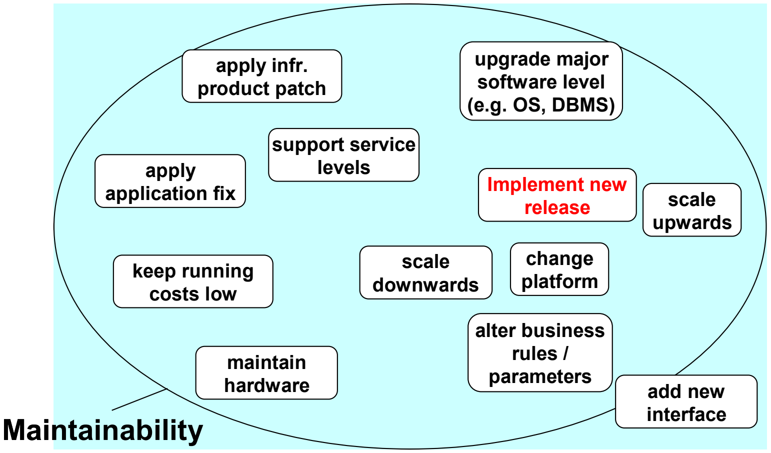
An example from everyday life

- Change Cases – I want to:
  - create arbitrary playlists and listen to them in any room of the house
  - play my newly created collection of MP3s as well as CDs
  - record from the radio / TV (whilst playing another source)
  - be able to search a catalogue of all my music
  - expand my music collection through online purchases
  - be protected from the failure of any single devices
  - …

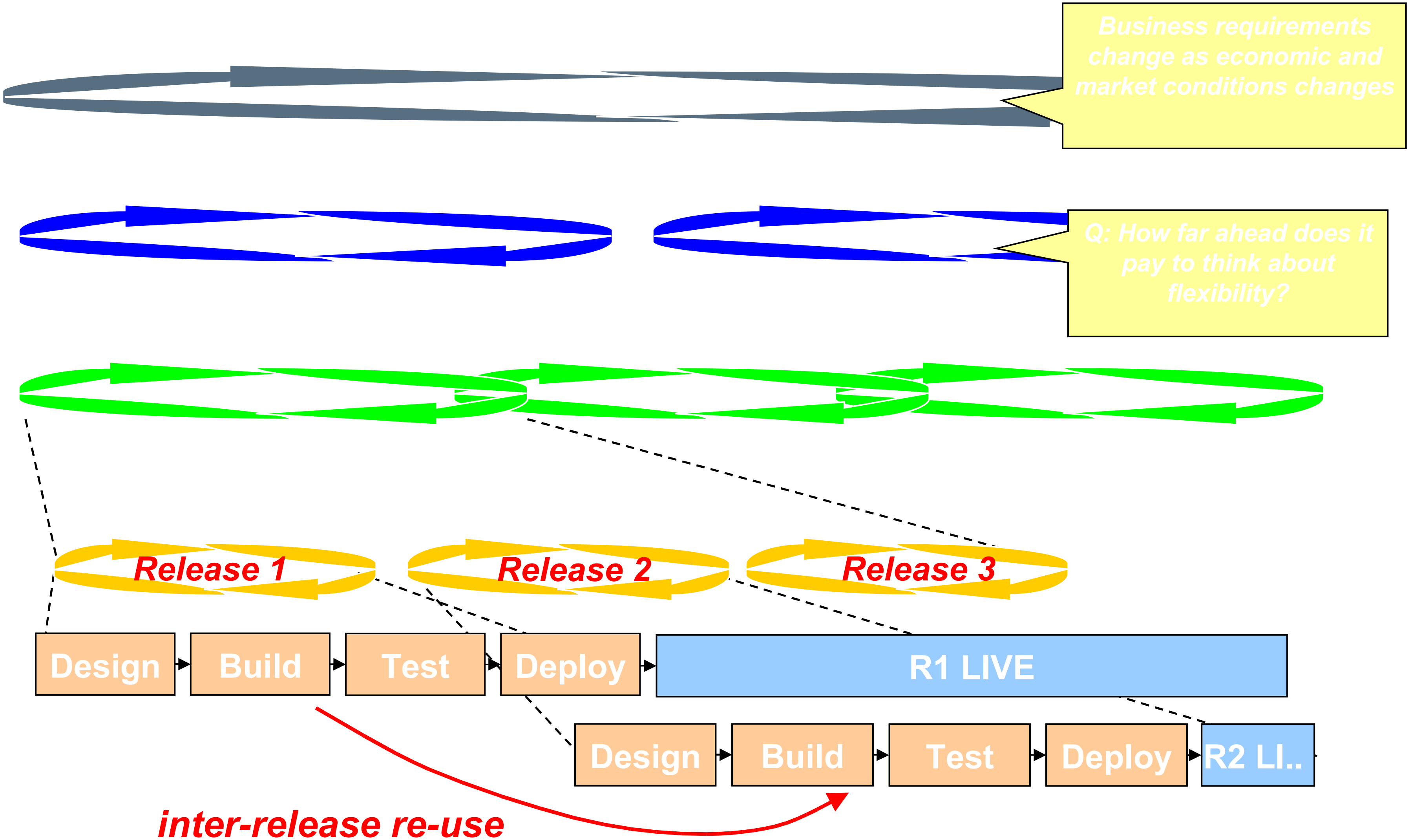


- Example constraints / issues:
  - I bought an expensive amplifier and don’t want to have to replace it
  - I currently only have speakers in one room
  - Difficult to wire through to other rooms
  - Wireless signals may not pass through walls / wireless transmission may not be of sufficient quality
  - Amplifier not connected to the computer
  - Devices cannot play and record simultaneously
  - Computer has run out of disk space …

What can the IT Architect do to help those who *maintain* and IT system? Examples ….



Taking the Long View – Business vs. Project Cycles

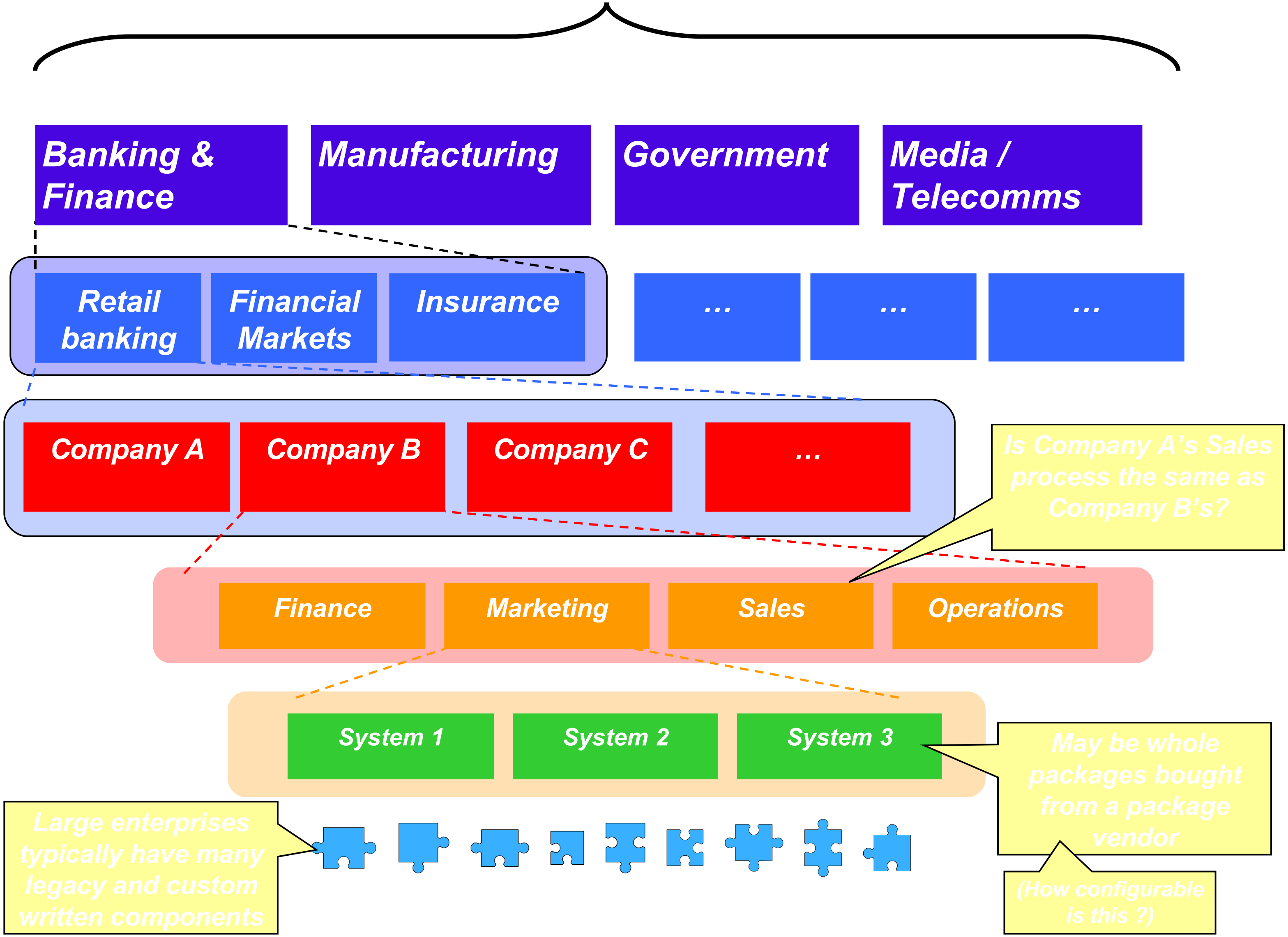


Business requirements change as economic and market conditions changes

Q: How far ahead does it pay to think about flexibility?

inter-release re-use and extension

What is a sensible scope of component flexibility & re-use?



Banking & Finance

Manufacturing

Government

Media / Telecomms

Retail banking

Financial Markets

Insurance

…

…

…

Company A

Company B

Company C

…

Is Company A's Sales process the same as Company B's?

Finance

Marketing

Sales

Operations

System 1

System 2

System 3

May be whole packages bought from a package vendor

(How configurable is this ?)

Large enterprises typically have many legacy and custom written components

Challenges from the definition of ‘Flexibility’

- Flexibility:
  - “The degree to which ..
  - .. a system can be changed or extended ..
  - .. to meet new or altered business requirements ..
  - .. with minimum cost, effort and impact to operations.”

- Implications
  - Need to be able to measure flexibility in some way (or at least define “success”)
  - Requires change mechanisms, identification of roles, and a extension/reuse framework
  - What is the conceivable scope of changing requirements?
  - Design and infrastructure needs to aim to support change <u>efficiently</u>

Sources of Flexibility & Extensibility constraints

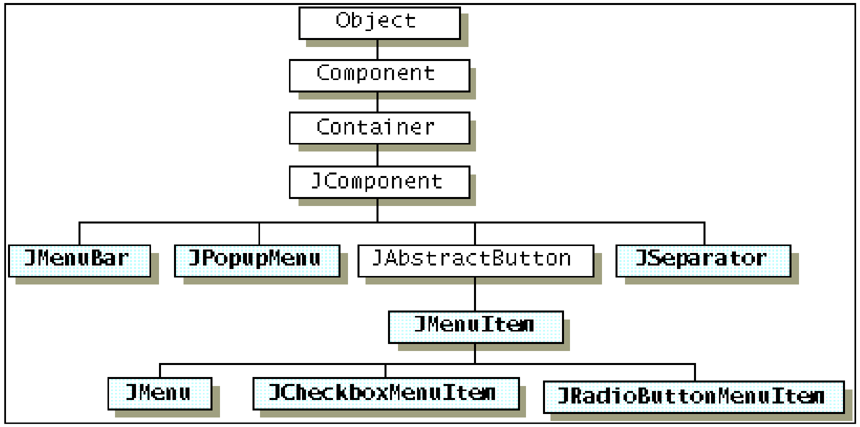
- Architectural & Technical constraints
  - Out of date technology base – cannot be migrated forward
  - Subsystems and components are tightly coupled
    - Can't replace one without replacing the other
  - Functional components not suitable for reuse
    - e.g. wrong level of granularity
  - Business rules hard coded
  - Scalability constraint (e.g. due to logical bottleneck)
  - Skills to modify systems are in low supply

- Constraints not directly caused by system design
  - Business organisation and processes are not flexible
  - No overall Enterprise Architecture or architectural governance
    - replicated functions and data
    - low degree of commonality
  - Client is not prepared to pay for flexibility during solution design and implementation
  - Impossible to see direction of change (! / ?)

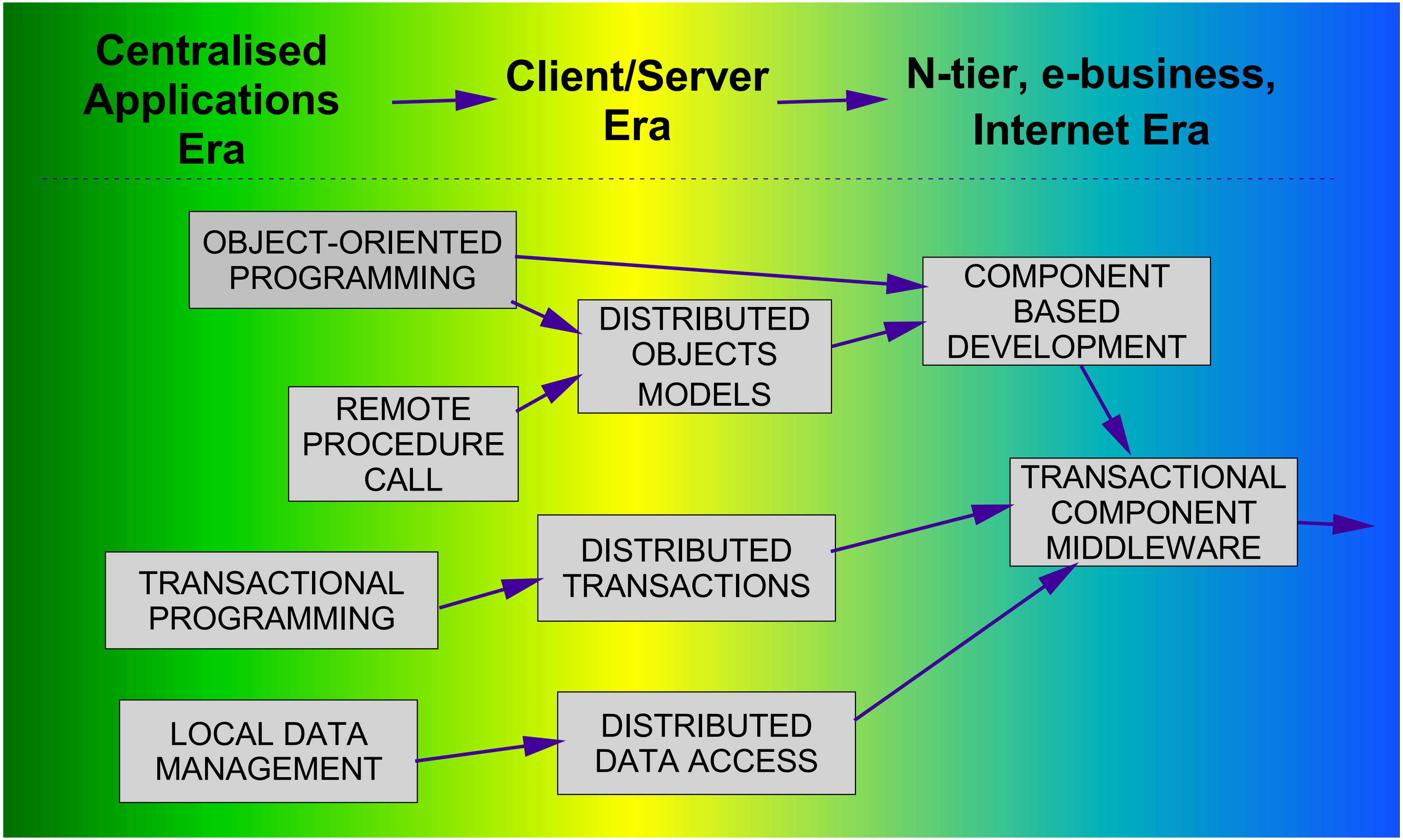
Exercise 1: who should be able make what changes to IT system?

- In order to support flexibility and extensibility objectives, wouldn’t it be better if business people (for whom the system was invented), could directly alter the capabilities (functionality and rules) within the system?
- What are the pros of this idea?
- What are the cons of this idea?
- How do you believe this scheme could be implemented?
- 5-8 minutes

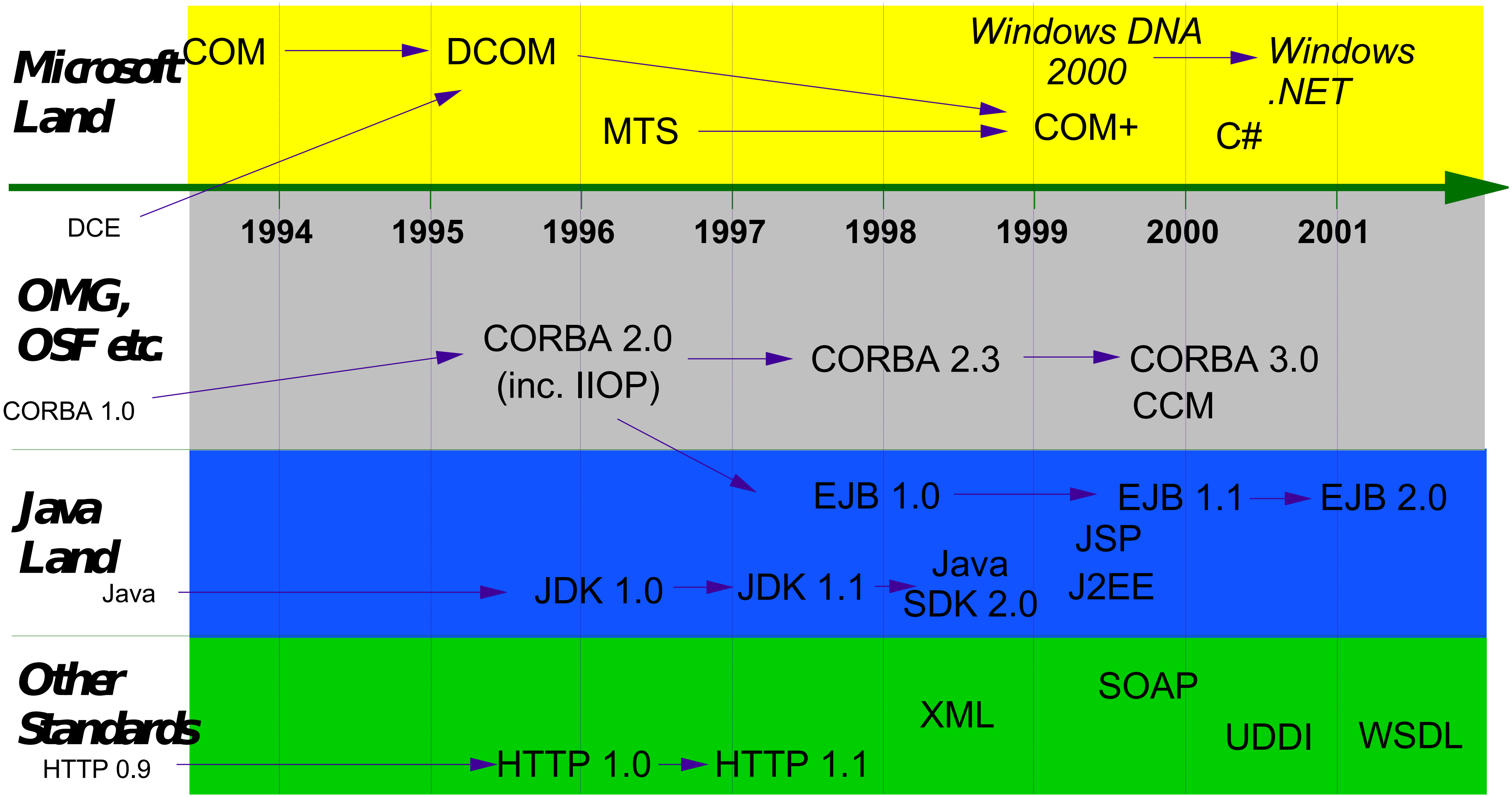
Object Orientated Programming – the original (?) solution to "reuse" and flexibility



Sidestep 1: Evolution of Middleware


Centralised Applications Era
Client/Server Era
N-tier, e-business, Internet Era
OBJECT-ORIENTED PROGRAMMING
REMOTE PROCEDURE CALL
TRANSACTIONAL PROGRAMMING
LOCAL DATA MANAGEMENT
DISTRIBUTED OBJECTS MODELS
DISTRIBUTED TRANSACTIONS
DISTRIBUTED DATA ACCESS
COMPONENT BASED DEVELOPMENT
TRANSACTIONAL COMPONENT MIDDLEWARE

Sidestep 2: A timeline of Distributed Applications Technologies (1994 – 2001)



Microsoft Land

COM → DCOM

DCE → DCOM

DCOM → COM+

MTS → COM+

Windows DNA 2000 → *Windows .NET*

C#

1994 1995 1996 1997 1998 1999 2000 2001

OMG, OSF etc

CORBA 1.0 → CORBA 2.0 (inc. IIOP) → CORBA 2.3 → CORBA 3.0 CCM

CORBA 2.0 (inc. IIOP) → EJB 1.0

Java Land

EJB 1.0 → EJB 1.1 → EJB 2.0

JSP

J2EE

Java → JDK 1.0 → JDK 1.1 → Java SDK 2.0

Other Standards

HTTP 0.9 → HTTP 1.0 → HTTP 1.1

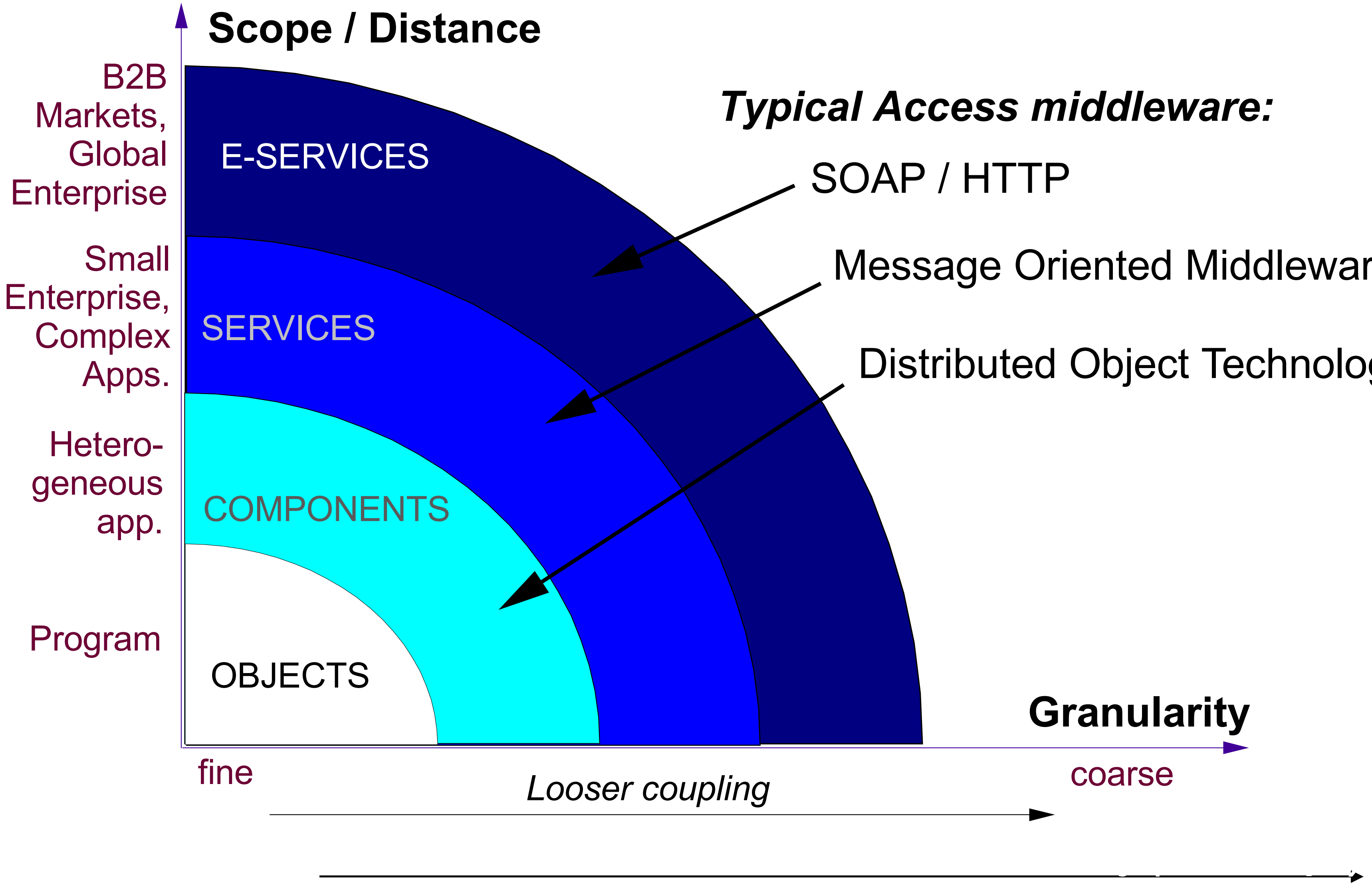
XML

SOAP

UDDI

WSDL

Application coupling – Gartner view



Scope / Distance

B2B Markets, Global Enterprise

Small Enterprise, Complex Apps.

Hetero-geneous app.

Program

E-SERVICES

SERVICES

COMPONENTS

OBJECTS

Typical Access middleware:

SOAP / HTTP

Message Oriented Middleware

Distributed Object Technology

Granularity

fine

coarse

Looser coupling

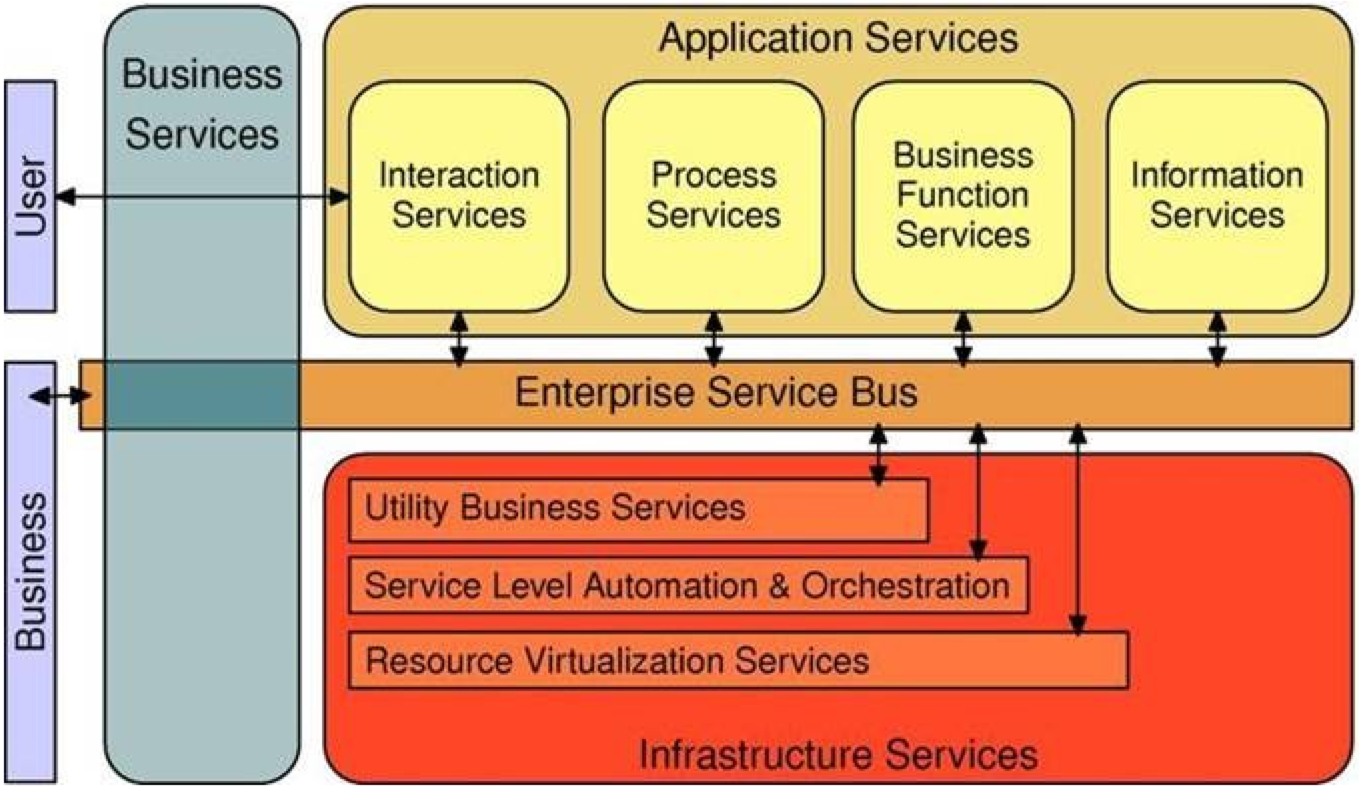
Three design flexibility watchwords to dance by

- Objectives in flexible system design

- Loose coupling (*arms out!*)
  - Meaning components are not tightly bound together (either logically or technically), giving freedom to alter component internals and implementations
  - The ‘interface’ or ‘service definition’ needs to stay the same in order to have zero impact on other components
- High cohesion (*elbows together!*)
  - Despite being loosely coupled, we still want components to ‘fit’ and work well together
  - The component model must still ‘make sense’, be logical
- Encapsulation (*arms above your head!*)
  - Components encapsulate (‘contain’, ‘capture’, ‘own’) a logical and consistent piece of functionality and/or data

(Semi-reprise from WDITADAD?) "Service Oriented Architecture"

- Shared logic & data, common services



What's really new?:

- service definition technology independent (excepting XML!)

- possible (if not always desirable) to perform runtime binding

The ‘Buy’ vs. ‘Build’ vs. ‘Construct’ debate

Strategy	Benefits (theoretical)	Implications and risks
Custom application development	• Applications can be built to meet exact requirements • Retain control of all technical standards, products and overall architecture • Flexibility is as good as your architecture	• Need to be able to capture requirements and develop efficiently • Require significant body of in-house or contracted skilled resource • Requires strong governance
Packages	• Exploit ‘best of breed’ functionality • Quicker / lower risk to implement (N.B. may be expensive to maintain …) • Fewer in-house skills required	• Must accept vendor ‘view of the world’ (e.g. data model, business process) • Need to integrate packages together • Flexibility dependent on vendor’s architecture • Can become reliant on vendor
Frameworks & toolkits	• Construct applications flexibly from frameworks to achieve high flexibility • Potentially lower cost and risk then custom application development	• Still reliance on vendor • Flexibility limited by scope of vision of the framework / toolkit • More complicated than straight package implementation

Trends to watch in flexible business application construction

Summary

Summary of Topics

Qualities and Constraints

quality of implementation must be validated

**** May your systems be secure,**
easy to use, and flexible in the face of change **