IT Architecture Module

Qualities & Constraints in IT Architecture

Security
Usability & Accessibility
Maintainability & Flexibility

Agenda

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

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**

Business

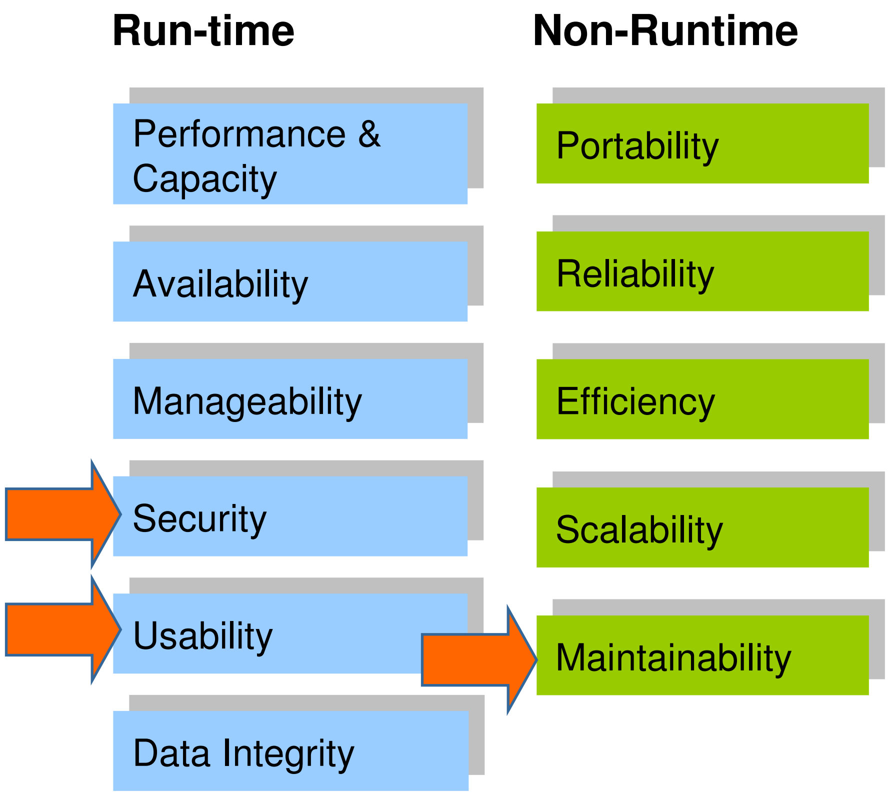
- Regulatory
- Organisational
- Risk Willingness
- Marketplace factors
- Schedule & Budget

Technical

- Legacy Integration
- Development Skills
- Existing Infrastructure
- Technology State of the art
- IT Standards

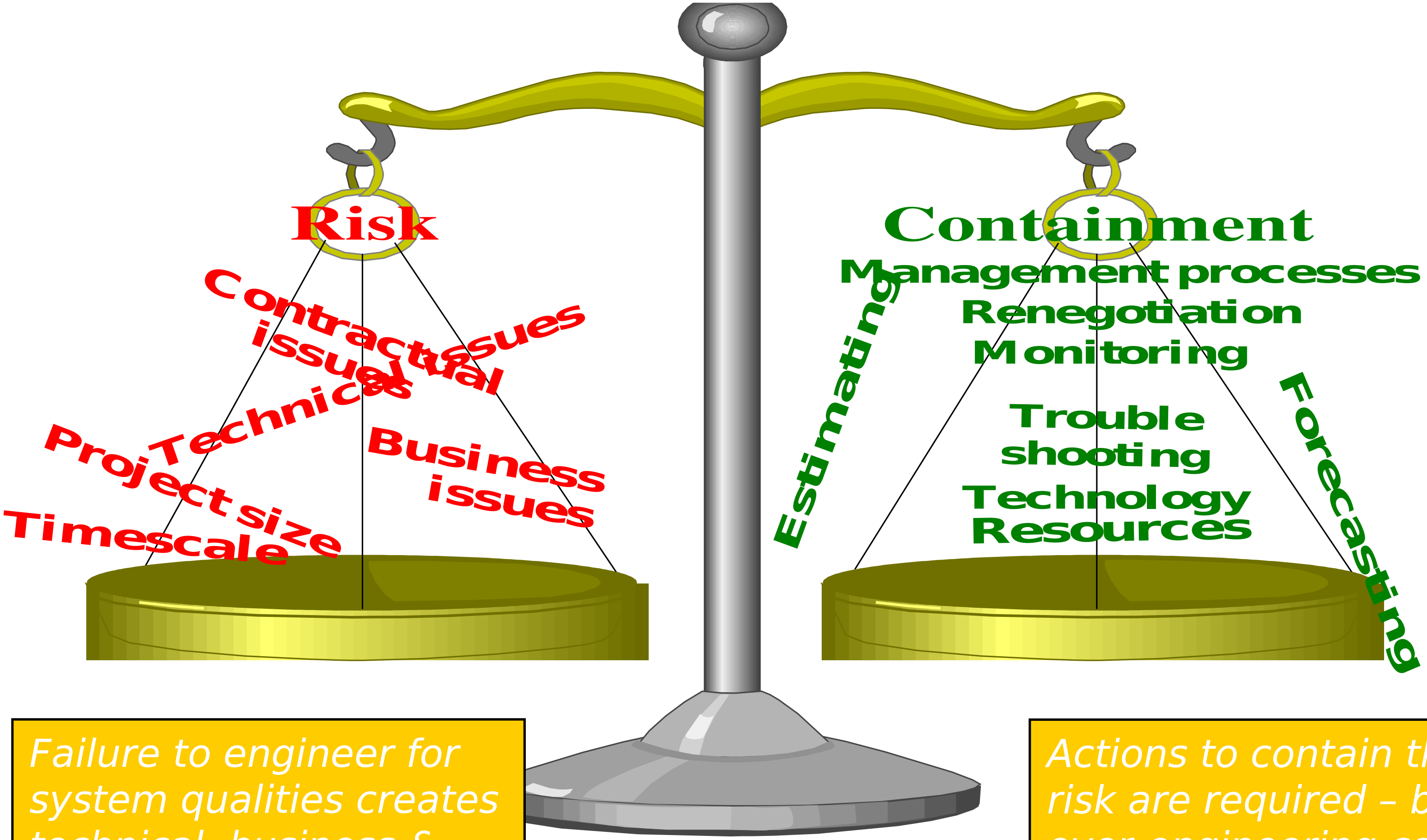
Qualities

- **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

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



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

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!)

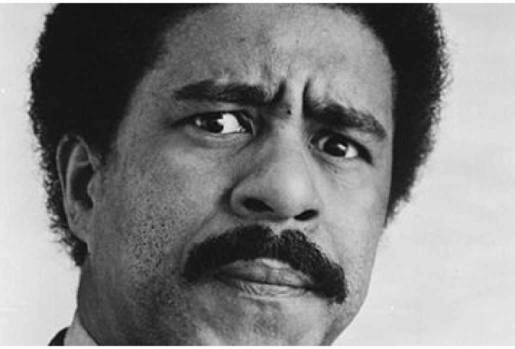
- The scale of the risk depends on the nature of the organisation(s) and the nature of the purpose of the system …

(Amusing?) Examples of insecure systems

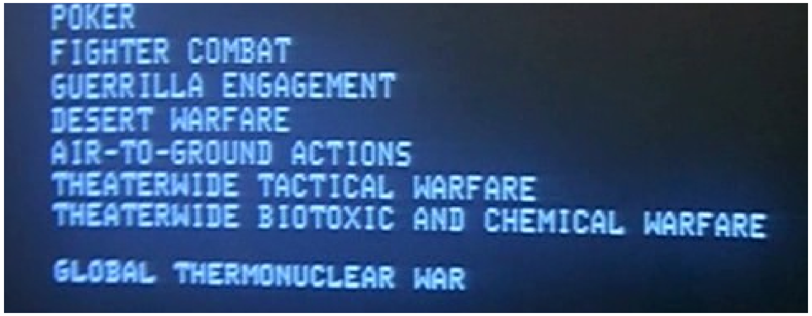
- Superman III – Richard Pryor’s character bypasses access controls by typing:

```
> override all security
```

.. into the console



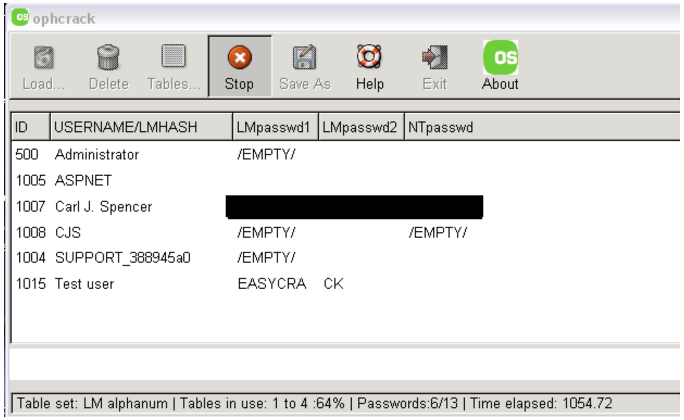
- In the film “War Games”, Matthew Broderick gains access to the WOPR computer using a password “backdoor”



```
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]		
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

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)

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

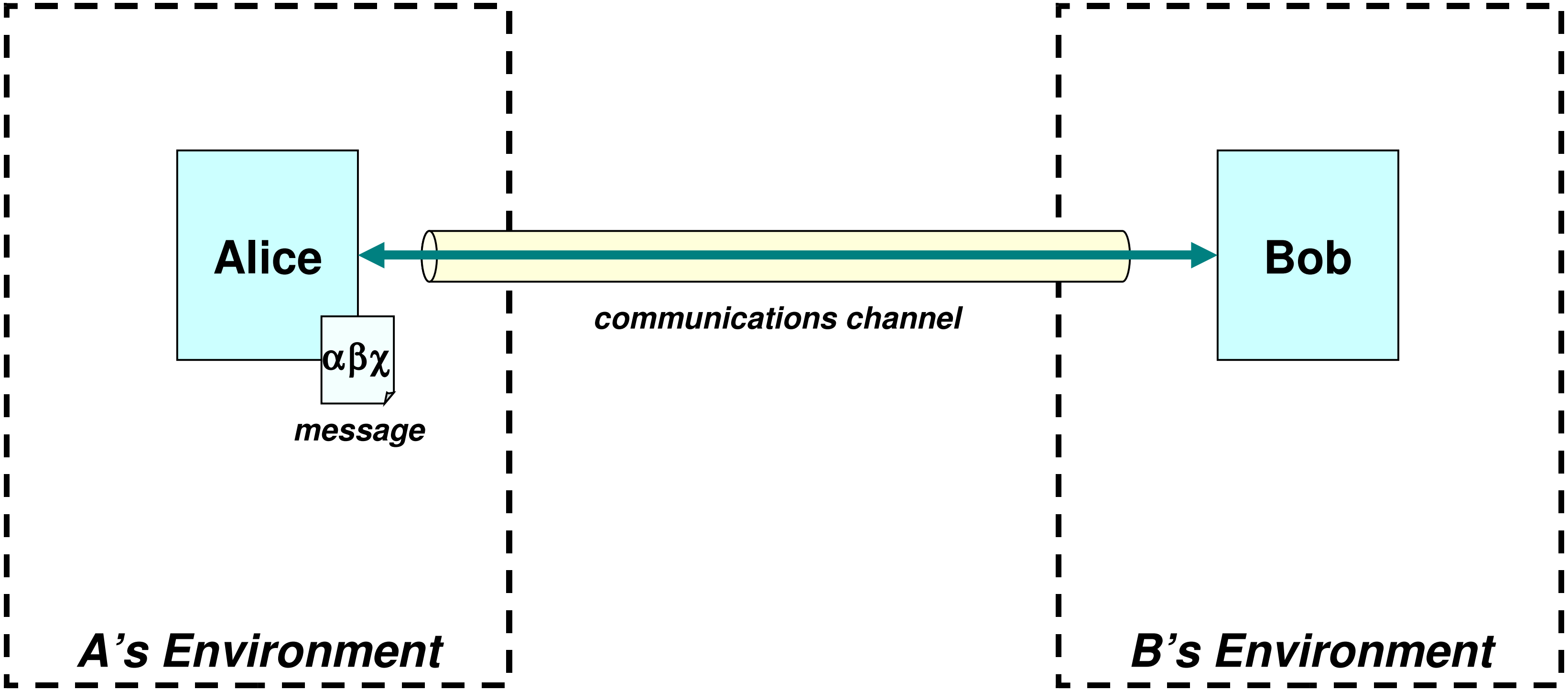
A few examples of sensitive assets

- 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 :

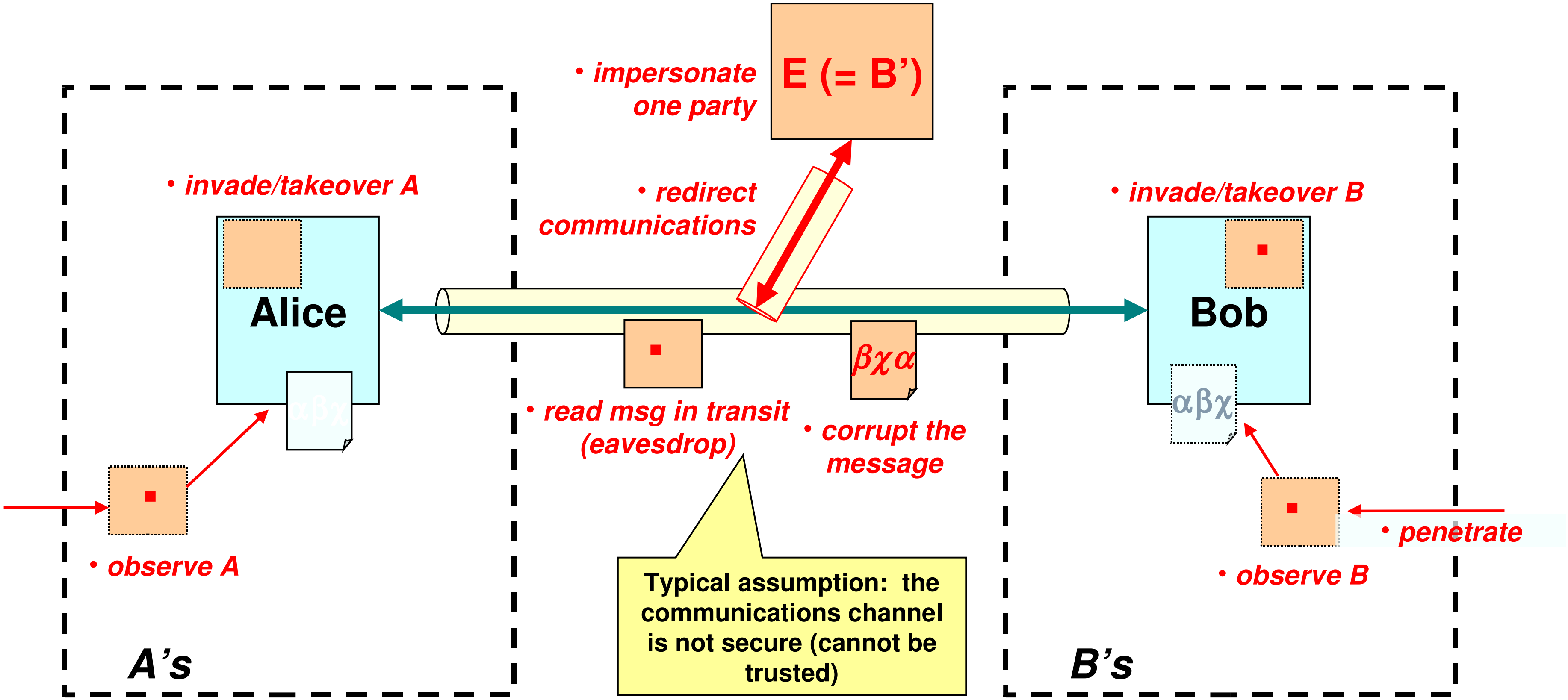
Fundamental Concepts

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



Exercise : 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

E (= B')

- invade/takeover A

- redirect communications

- invade/takeover B

Alice

Bob

αβχ

βχα

- read msg in transit (eavesdrop)

- corrupt the message

- observe A

- penetrate

- observe B

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

A's

B's

=> 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
- {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)

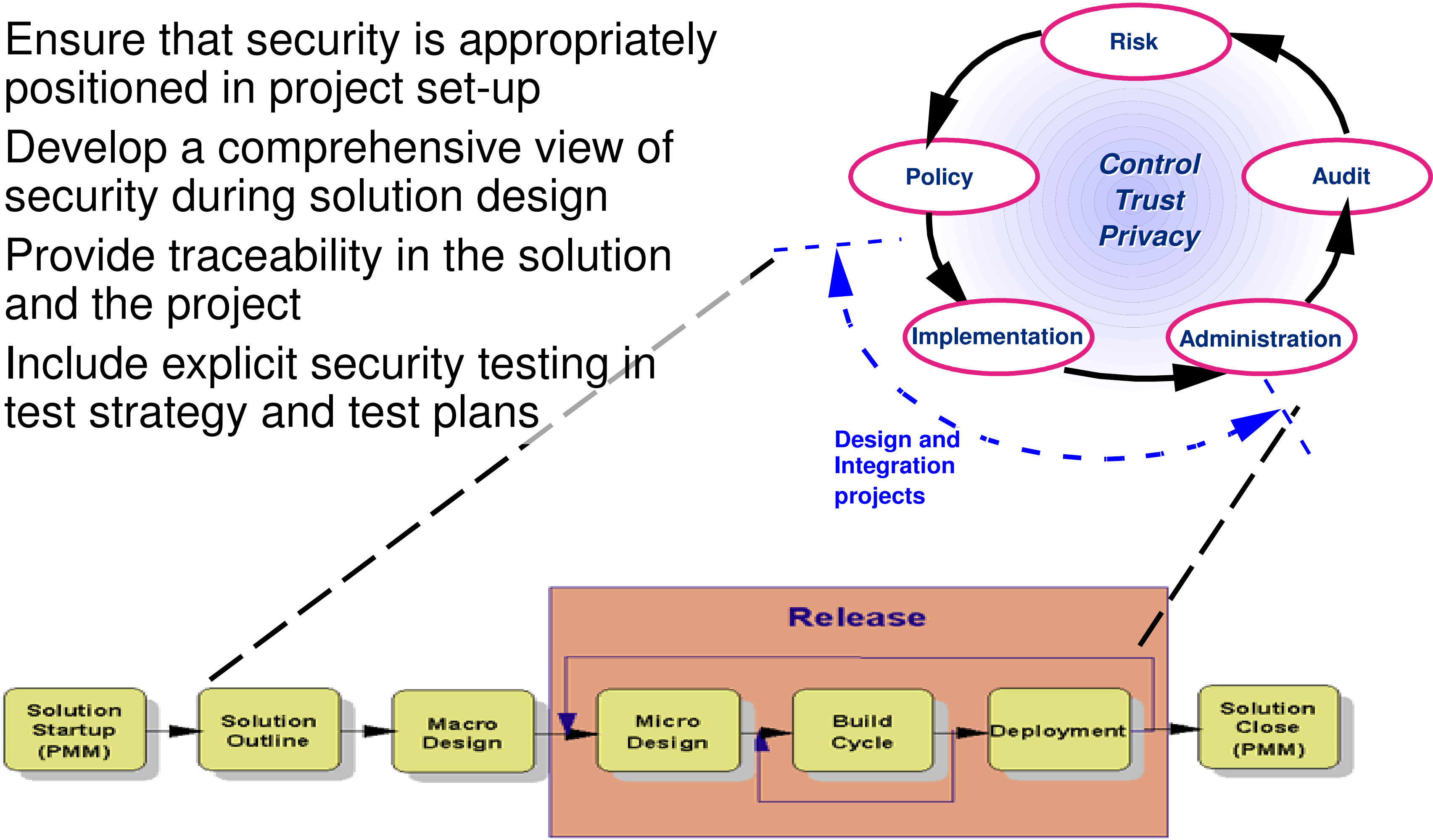
- **Integrity** – protecting the “truth”
  - The quality of a system whereby data and processing *always* conforms to the specified rules and constraints within the system
- **Auditable** – what did they do?
  - The trail of evidence proving the activities that have been performed on an internal asset – 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

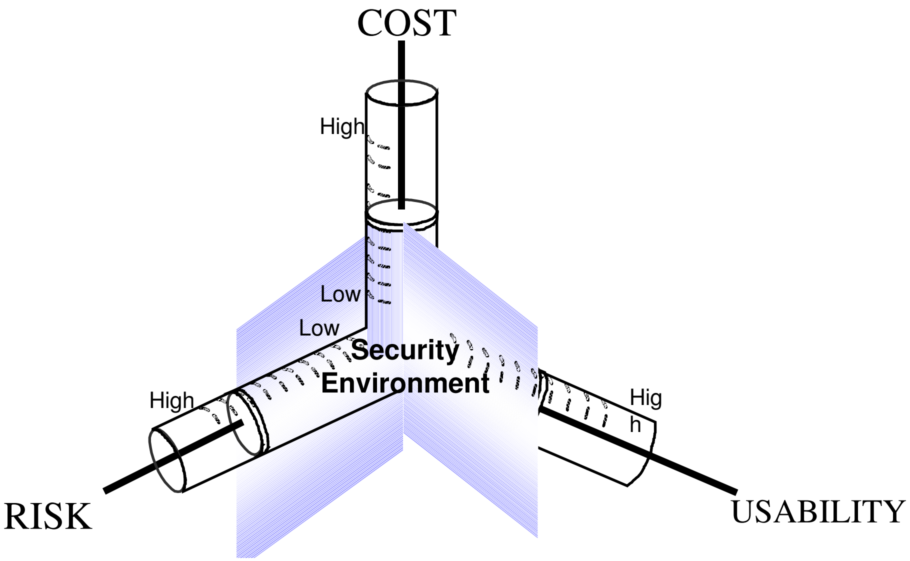
- Ensure that security is appropriately positioned in project set-up
- Develop a comprehensive view of security during solution design
- Provide traceability in the solution and the project
- Include explicit security testing in test strategy and test plans



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

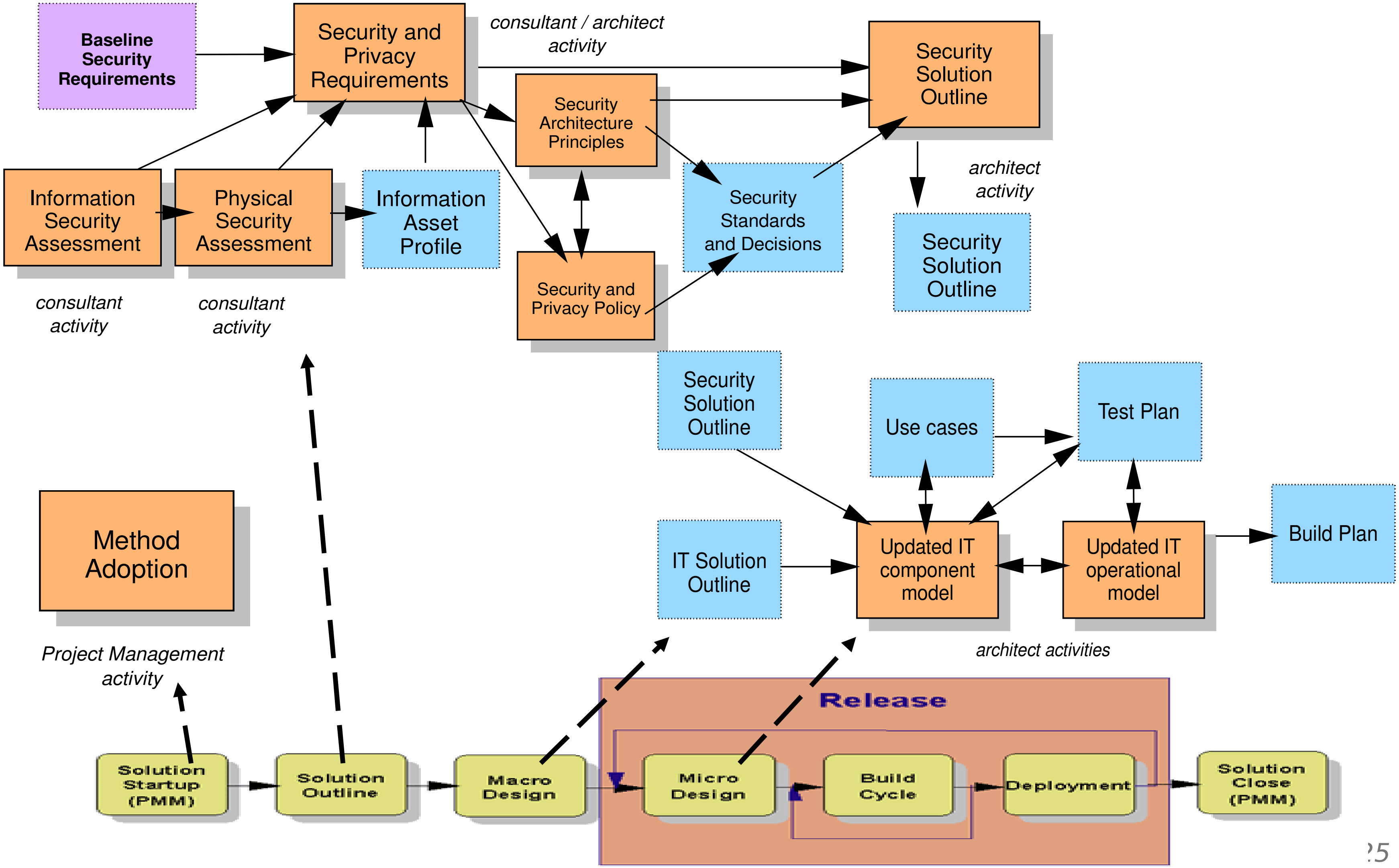
From a security perspective, all IT solutions must balance three conflicting factors:

- **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

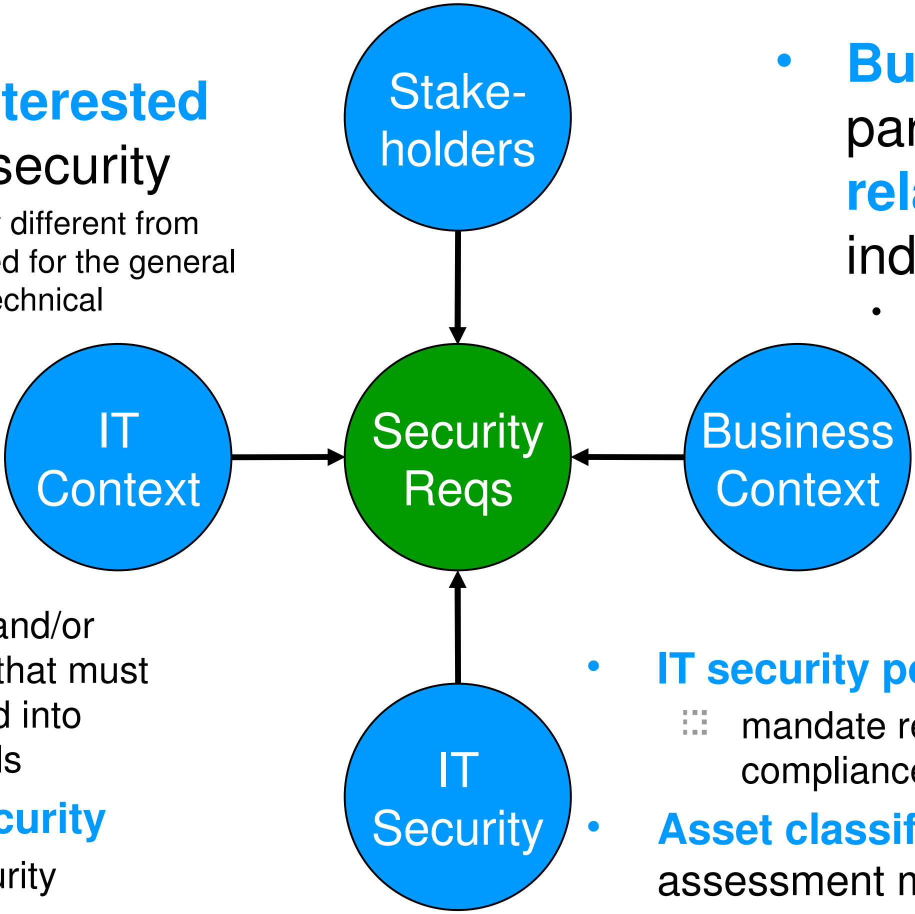
		Phase				
		Solution	Macro Des	Micro Des.	Build	Deploy
Domain	Bus	Bus Env Asset Profile Risk Assess	Authorisation & Access Control Security Bus rules			
	Arch	Client IT Env Threat Analysis Security NFRs	Comp/Op Arch Security Test Strat Workstream Security	Authorised Dataflows		
	App	Security Use Case 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

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



- **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

- **Corporate IT architectures**
  - pre-requisites and/or dependencies that must be incorporated into security controls
- **Enterprise IT Security**
  - mandated security standards, technologies, and services

- **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

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

- ❑ The application runs “within” a secure infrastructure
- ❑ Authentication of users and authorisation of their actions
- ❑ Control of access to information, including data privacy
- ❑ Protection from unauthorised disclosure or modification of information, in transit and in storage (including backups) – including data protection
- ❑ Capture, storage, protection, and management of transaction-level audit trails

Infrastructure security aspect

- ❑ The infrastructure supports one or more business applications
- ❑ Secure server and middleware environment
- ❑ Network-level access controls
- ❑ Identity and Access Management infrastructure
- ❑ Desktop security environment
- ❑ Wide Area Network environment

- 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

Security : Technology and Operational Architecture

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

- **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

- **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

- **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.

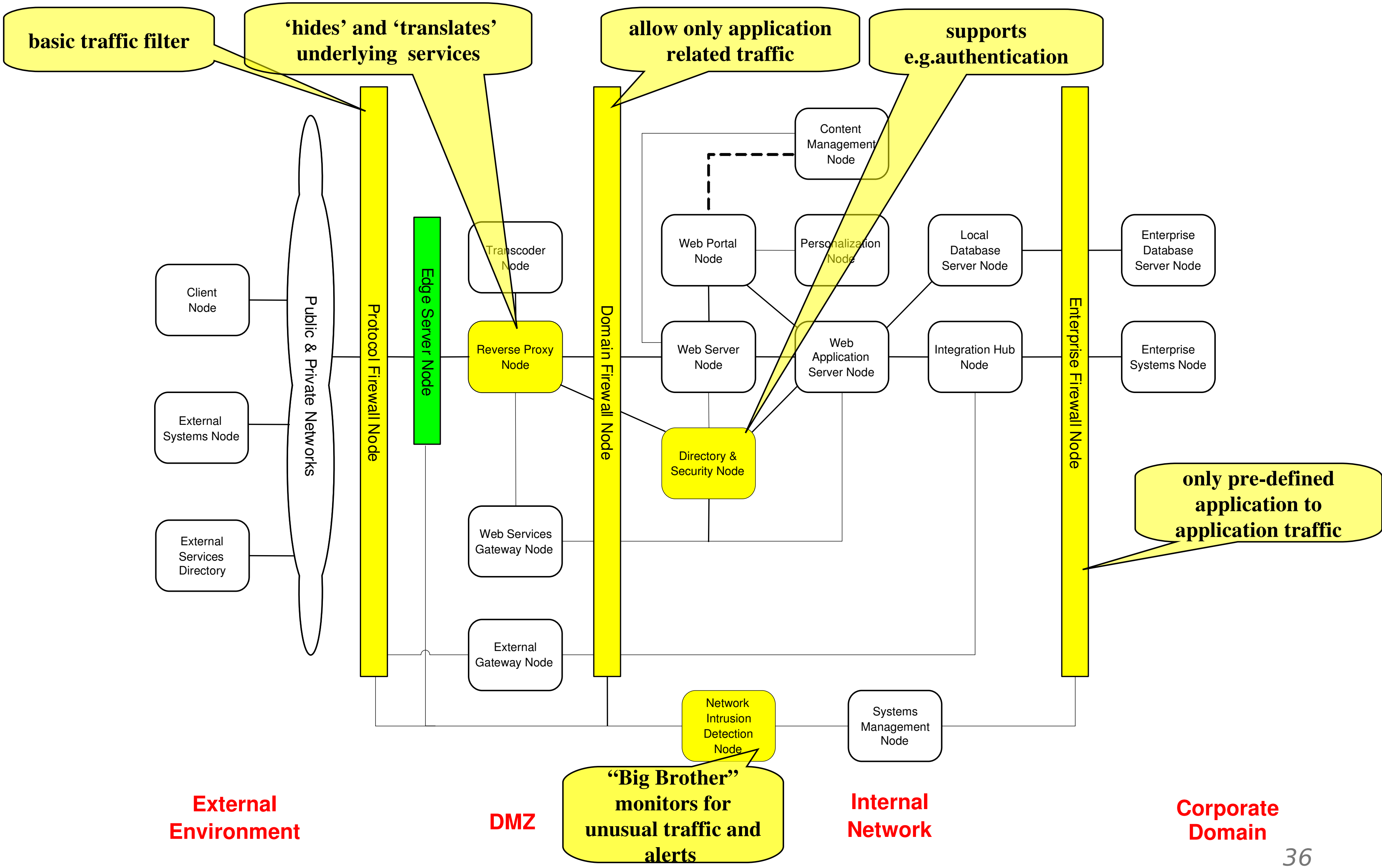
We need to elaborate the zone classification to reflect who has management control of a zone…

- 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

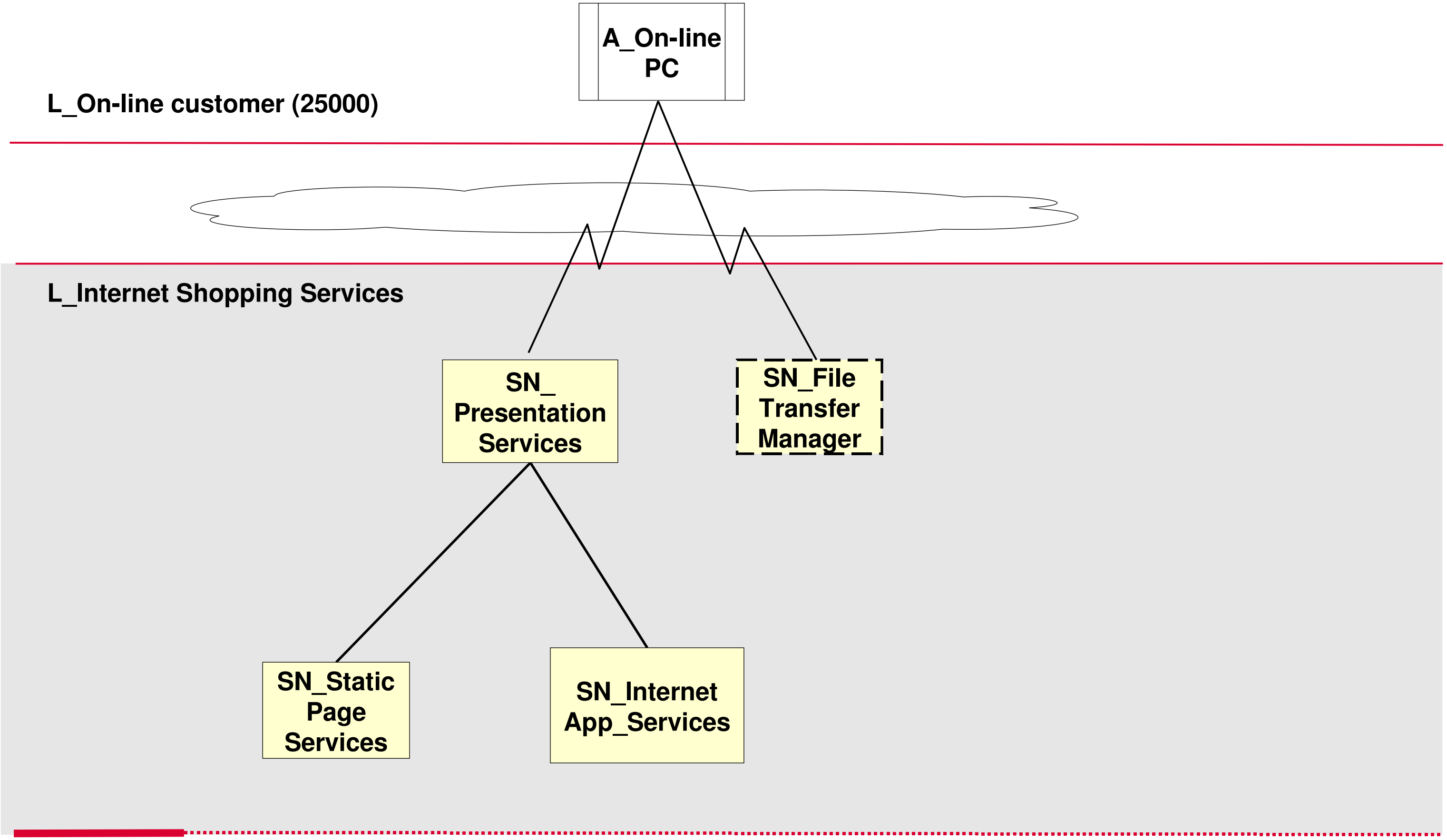
- **Firewall**
  - A hardware or software component which protects against unauthorised network access into or out of a particular zone
  - Firewalls aim to filter unwanted traffic out by observing packet contents and applying rules
- **Security & directory servers**
  - Dedicated servers hosting components 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)

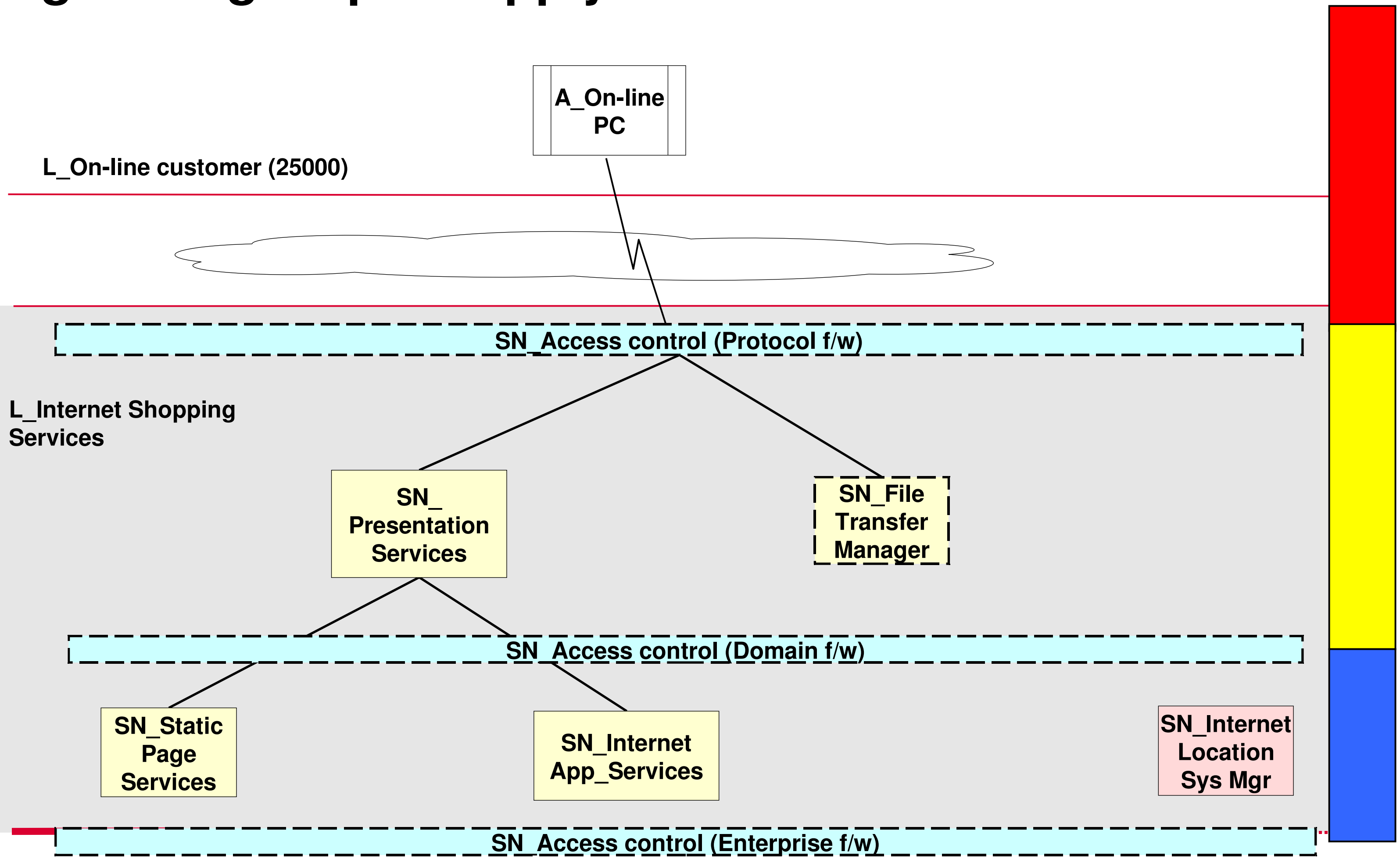

basic traffic filter
'hides' and 'translates' underlying services
allow only application related traffic
supports e.g.authentication
Content Management Node
Client Node
External Systems Node
External Services Directory
Public & Private Networks
Protocol Firewall Node
Edge Server Node
Transcoder Node
Reverse Proxy Node
Web Services Gateway Node
External Gateway Node
Domain Firewall Node
Web Portal Node
Personalization Node
Local Database Server Node
Web Server Node
Web Application Server Node
Integration Hub Node
Directory & Security Node
Enterprise Firewall Node
Enterprise Database Server Node
Enterprise Systems Node
only pre-defined application to application traffic
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

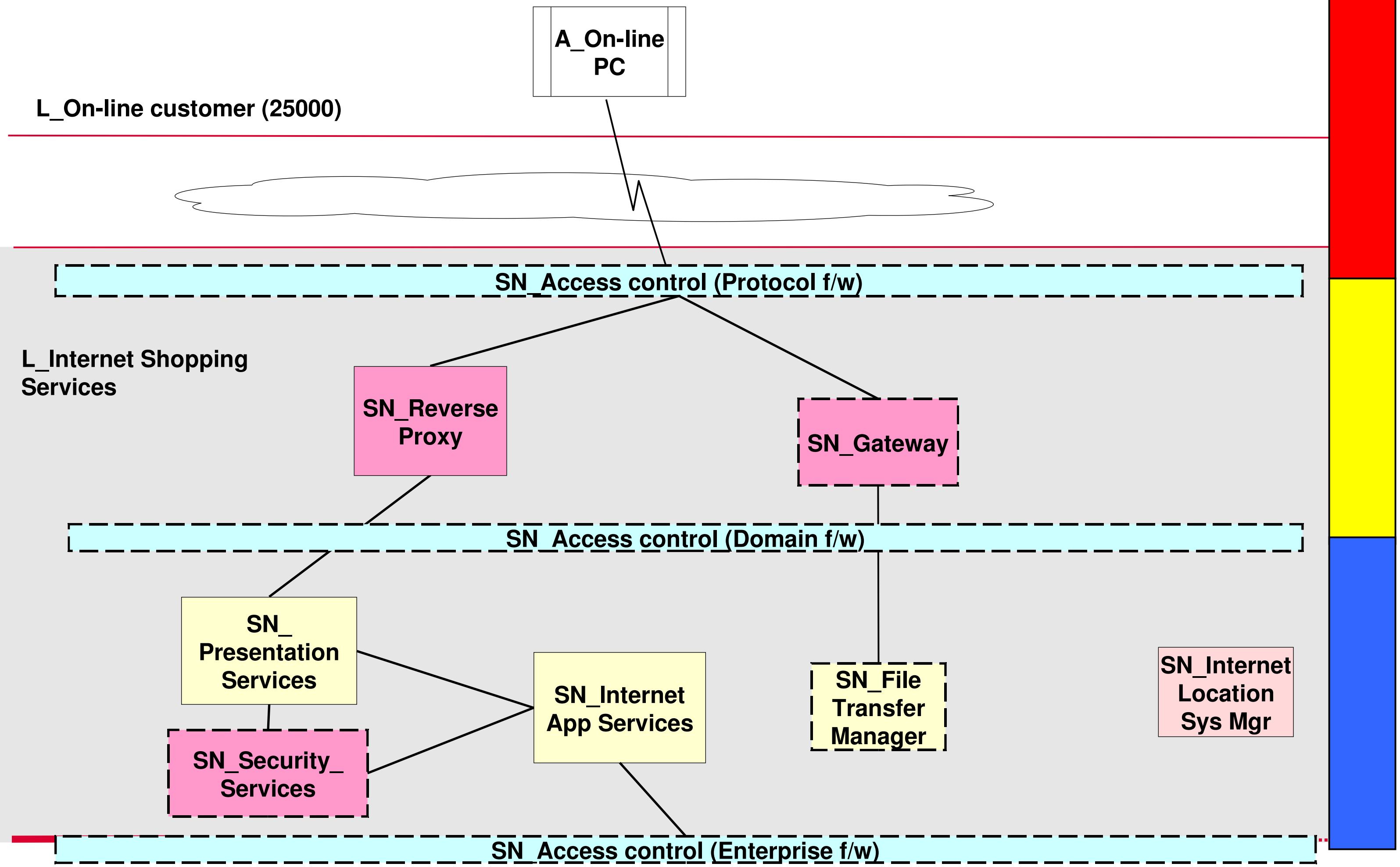
Starting point – simple (and insecure!) architecture



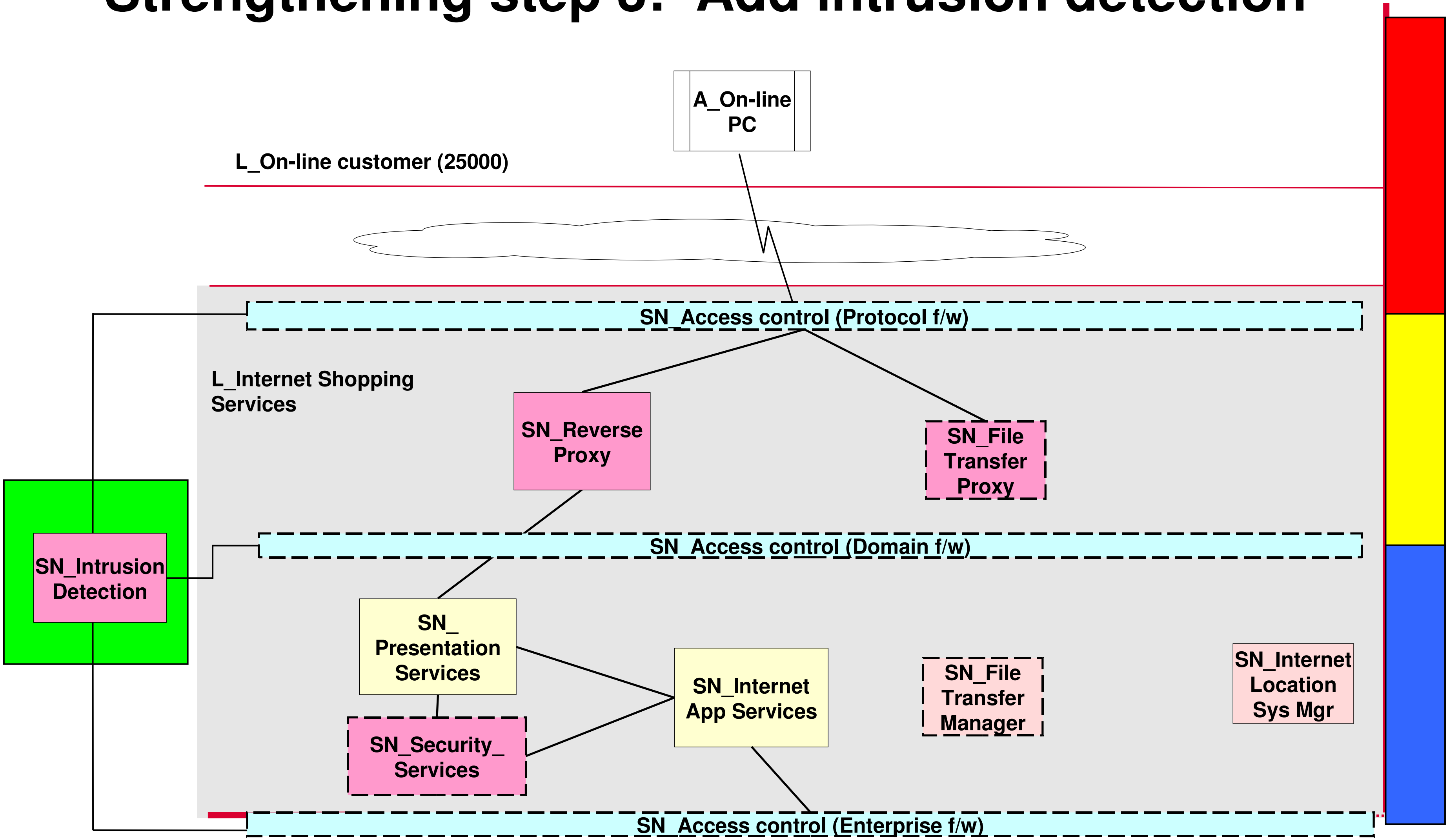
Strengthening step 1: Apply firewall and zone model


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_Intrusion Detection
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)

Accessibility, Usability & People Centred Design

Accessibility, Usability and People Centred Design

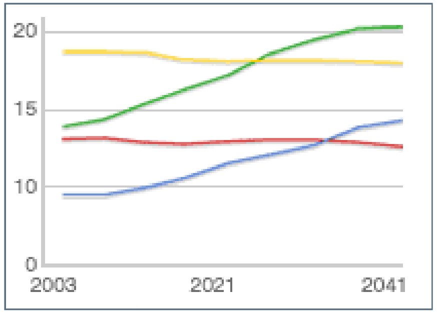
- Consider:
  - Accessibility – making systems available to as wide a range of people as possible
  - Usability – making systems easy to use

- 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

Ageing workforce



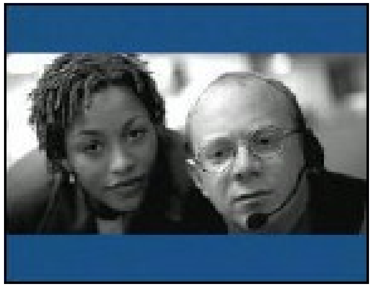
- By 2025, more than a third of the UK's population will be over 55.
- There is a trend of extended working life. The long term aspiration is:
  - To achieve an employment rate equivalent to 80% of the adult population, including:
    - One million **older workers** into employment
    - One million **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.

> *“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

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



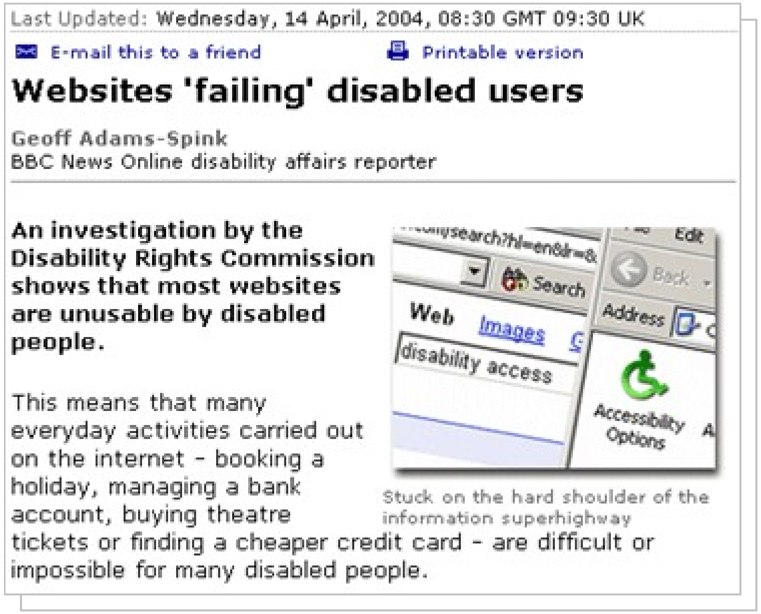
- People
  - Any direct or indirect user of a system
  - Staff, managers, customers, citizens, learners, and so on

- 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."**

Accessibility & Usability: Method and Approach

Inclusive design relies on a rigorous process

1. Business opportunity

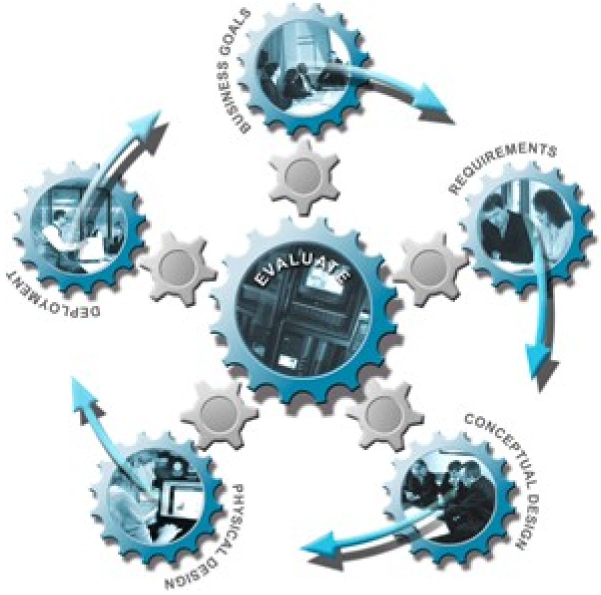
Defining business goals, stakeholder value, **target audiences**, opportunities, risks, segmentation.

5. Development & Training

Coding validated concepts and designs following **defined accessibility standards**

4. Physical design

Applying crafted and flexible representations to increase **access**, credibility and appeal.



2. Understanding users

Researching goals, **values**, **tasks**, context of use, **barriers to use**, environment, **access mechanisms**.

3. Conceptual design

Creating consistent concepts and behaviours matching **user's cognitive constraints**

Evaluation is central

Iterative evaluations remove errors, **check access**, reduce risk and **ensure targets are met.** Evaluations can also be used to identify and quantify new opportunities

(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

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.

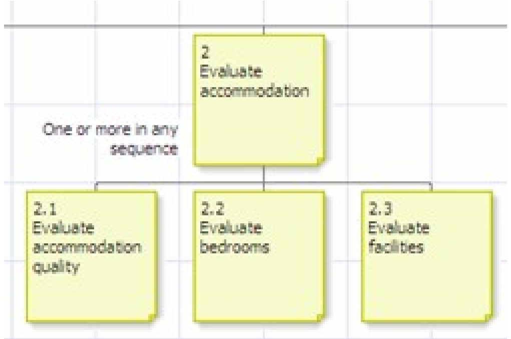
- Provides a forum to **reassess** business, design and development **priorities** as a result of the user research findings.

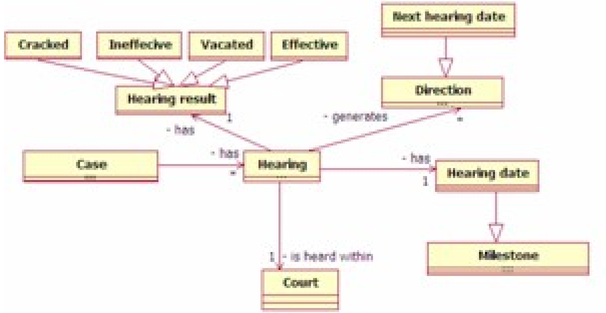
Conceptual design

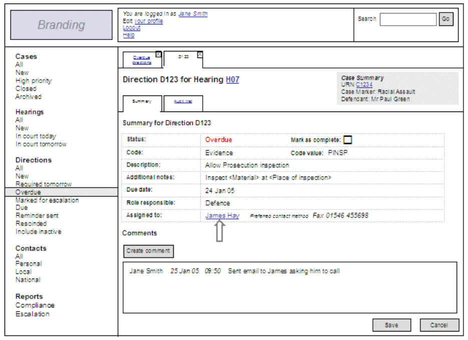
In general, 70% of usability problems are as a results of errors within the conceptual model

- 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







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

Direction D123 for Hearing H07

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

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

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

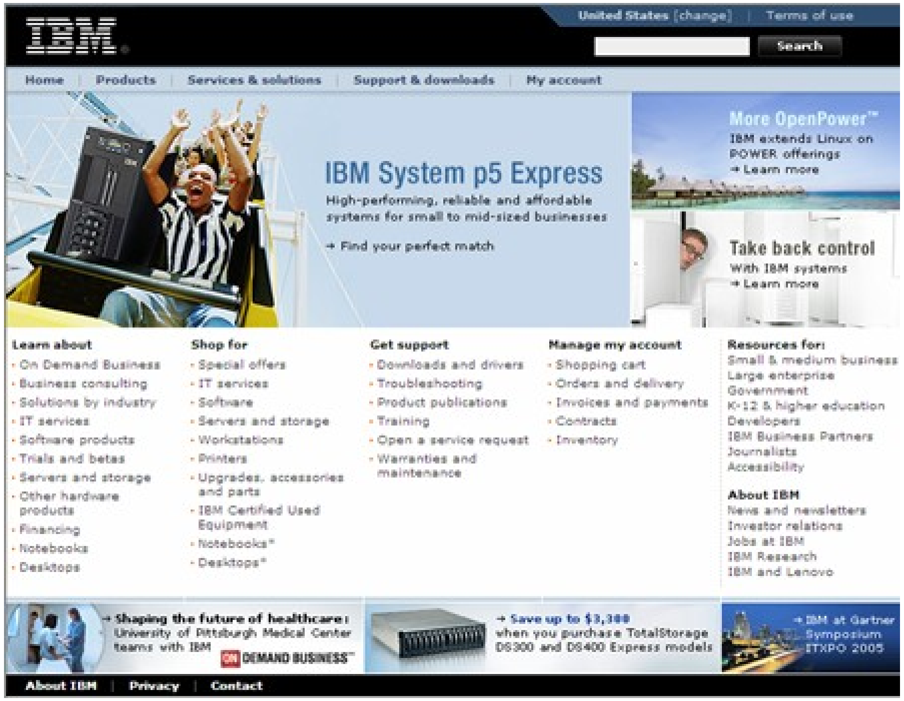
Physical design

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



IBM System p5 Express

High-performing, reliable and affordable systems for small to mid-sized businesses

→ Find your perfect match

More OpenPower™

IBM extends Linux on POWER offerings

→ Learn more

Take back control

With IBM systems

→ Learn more

Learn about
- On Demand Business
- Business consulting
- Solutions by industry
- IT services
- Software products
- Trials and betas
- Servers and storage
- Other hardware products
- Financing
- Notebooks
- Desktops

Shop for
- Special offers
- IT services
- Software
- Servers and storage
- Workstations
- Printers
- Upgrades, accessories and parts
- IBM Certified Used Equipment
- Notebooks*
- Desktops*

Get support
- Downloads and drivers
- Troubleshooting
- Product publications
- Training
- Open a service request
- Warranties and maintenance

Manage my account
- Shopping cart
- Orders and delivery
- Invoices and payments
- Contracts
- Inventory

Resources for:
Small & medium business
Large enterprise
Government
K-12 & higher education
Developers
IBM Business Partners
Journalists
Accessibility

About IBM
News and newsletters
Investor relations
Jobs at IBM
IBM Research
IBM and Lenovo

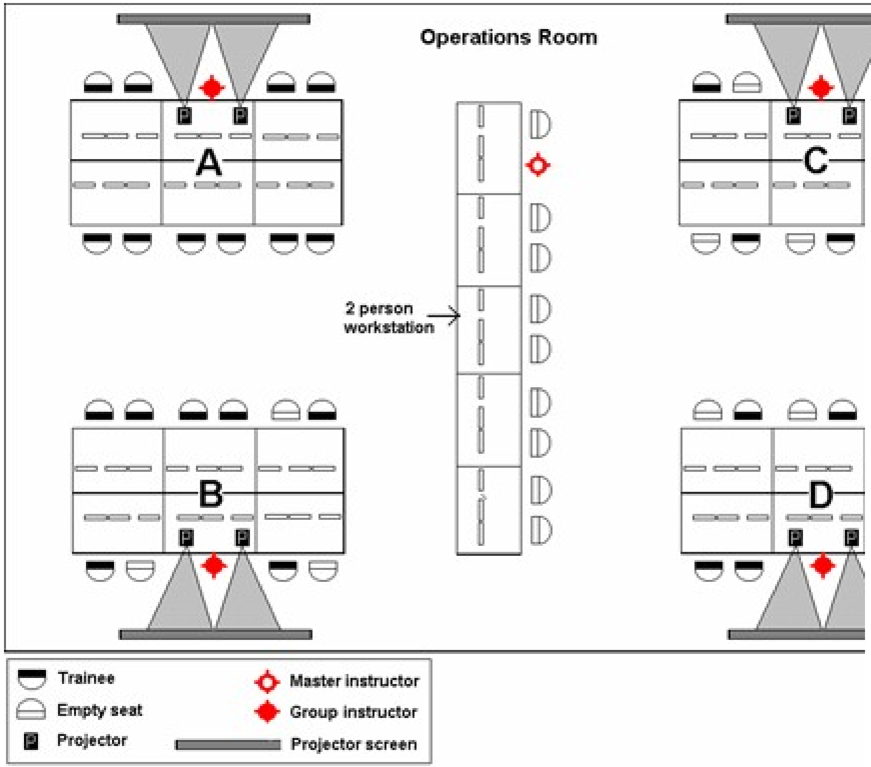
→ Shaping the future of healthcare: University of Pittsburgh Medical Center teams with IBM ON DEMAND BUSINESS™

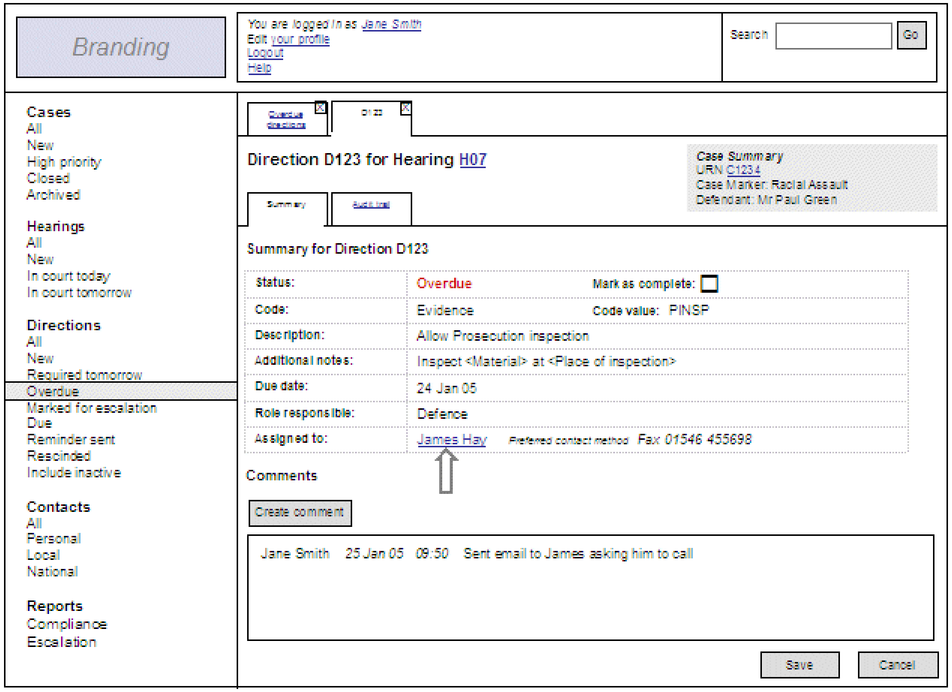
→ Save up to $3,388 when you purchase TotalStorage DS300 and DS400 Express models

→ IBM at Gartner Symposium ITXPO 2005

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





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

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

Direction D123 for Hearing H07

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

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		

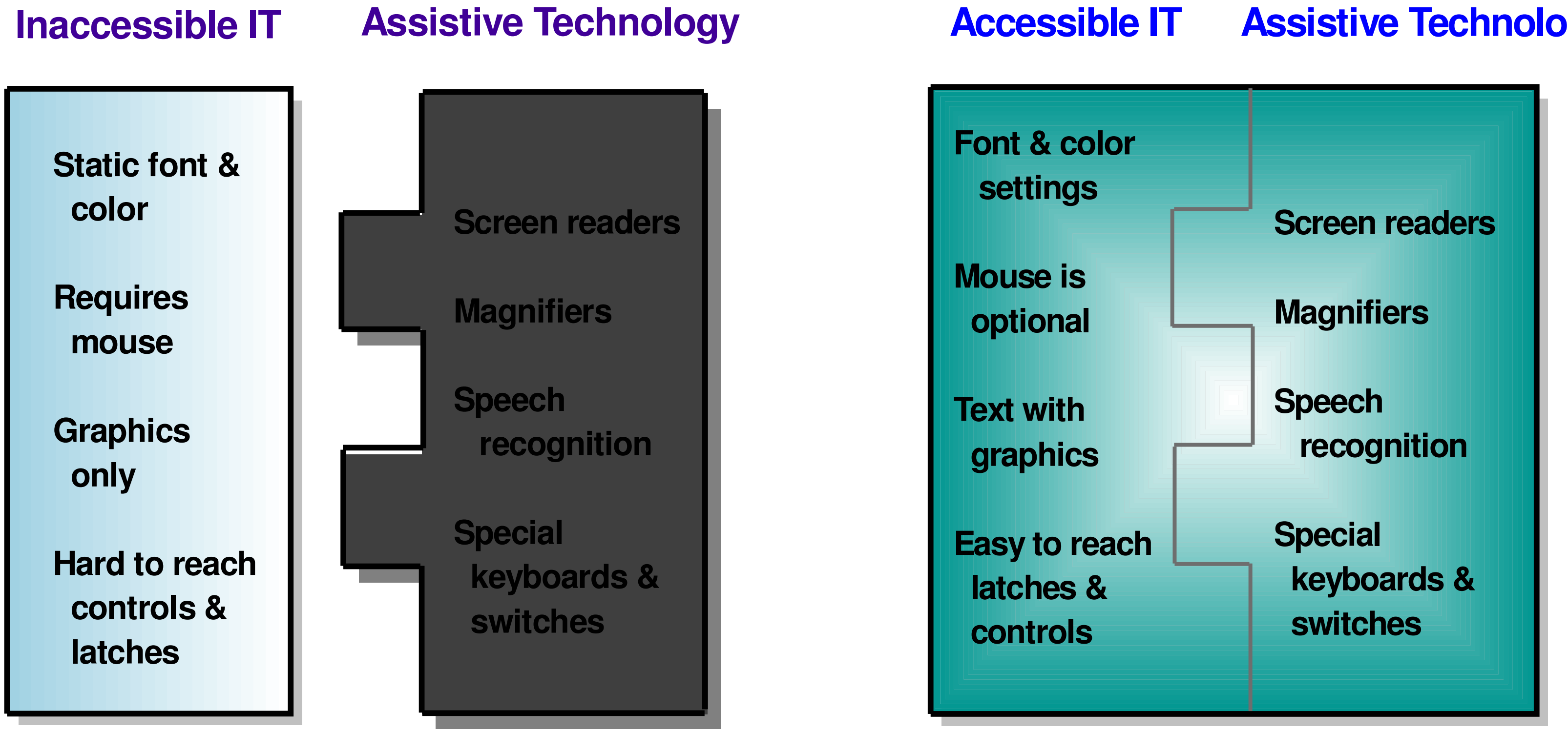
Comments

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

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

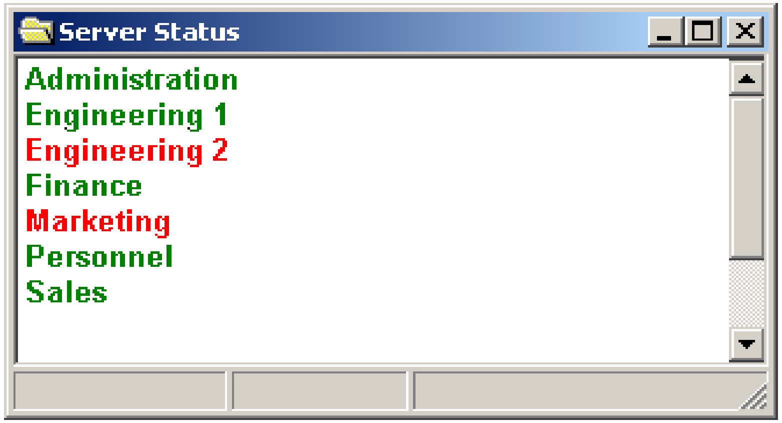
Speech recognition

Special keyboards & switches

Standards and APIs: MSAA, JAAPI, standard windows controls

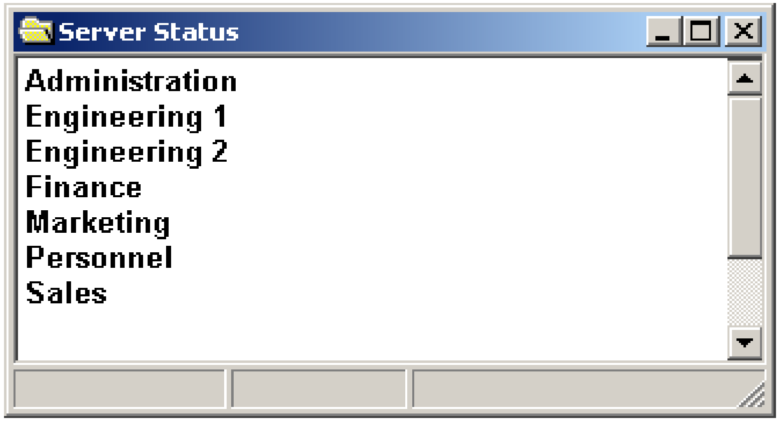
What are some examples of systems that comply with IBM and Government accessibility guidelines?

- 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



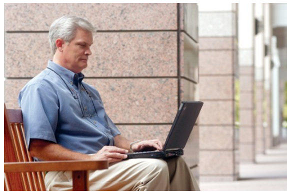
Server Status

Administration
Engineering 1
Engineering 2
Finance
Marketing
Personnel
Sales

Accessibility tools

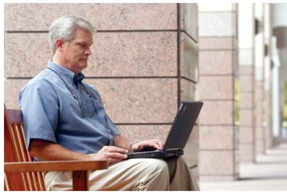
Disability *Assistive technologies can help many people with physiological disabilities*		Example Assistive technologies
Vision	Includes: • people who have a registered disability such as those who are blind, or have limited vision • people who are not registered but still have a visual impairment such 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



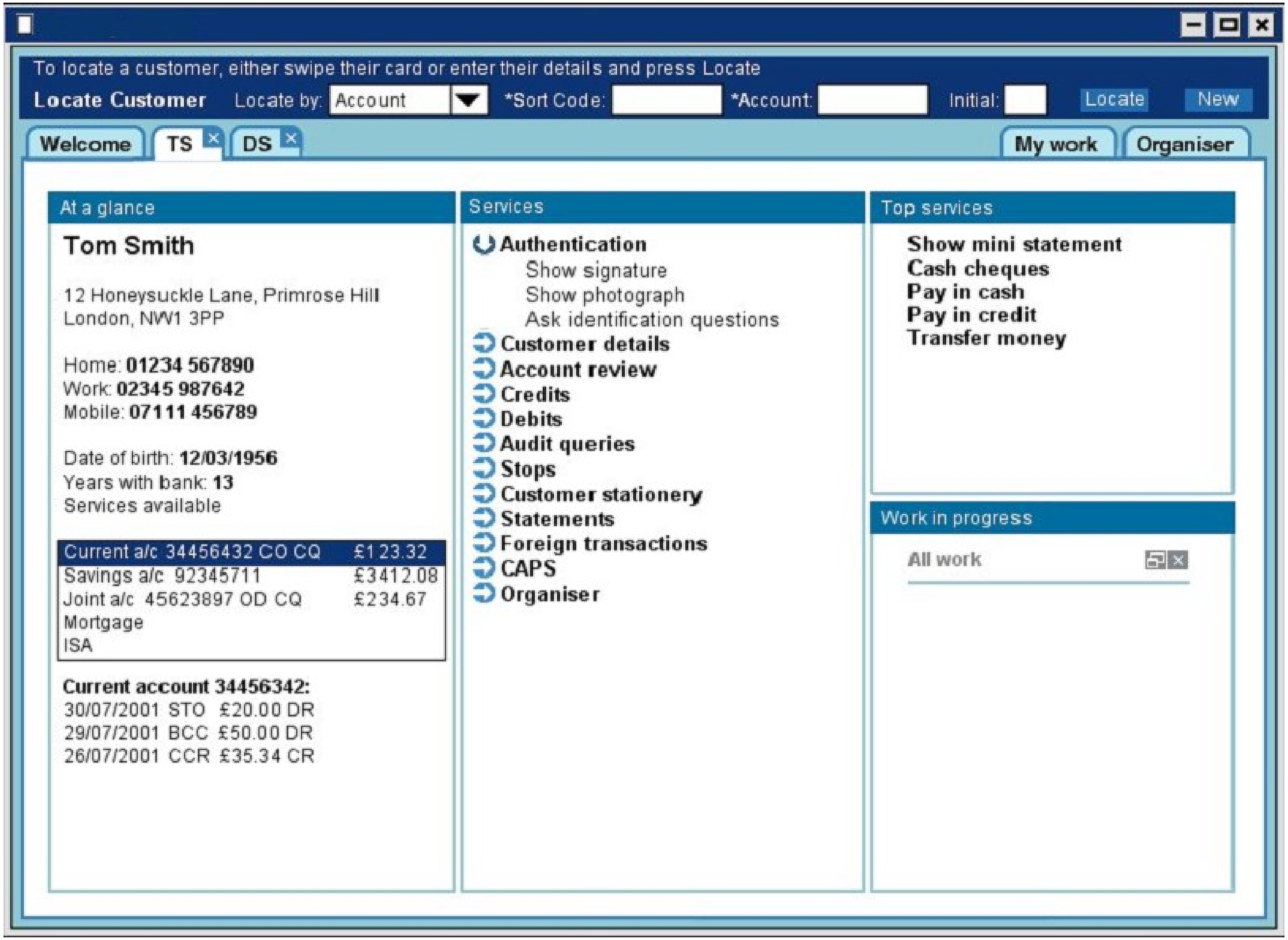
Cognitive impairment		Design approaches
Intelligence *Defined as the ability to solve problems through reasoning and experience*	Includes: • People whose ability to complete tasks is compromised by a lack of understanding and reasoning.	Design for ease of learning, simplified task models, structured 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

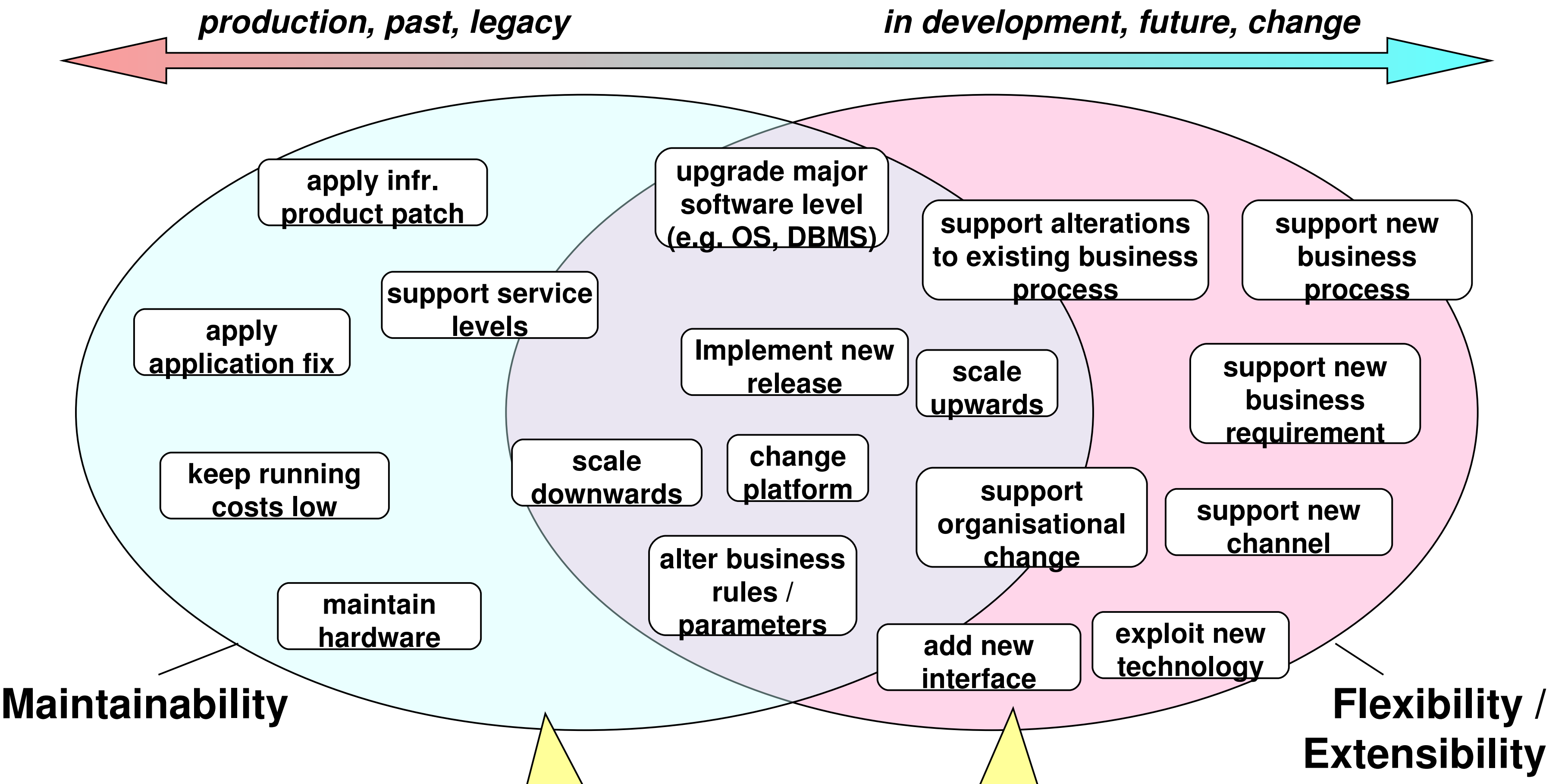
Maintainability & Flexibility in IT Systems

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


production, past, legacy
in development, future, change
apply infr. product patch
upgrade major software level (e.g. OS, DBMS)
support alterations to existing business process
support new business process
support service levels
apply application fix
Implement new release
scale upwards
support new business requirement
keep running costs low
scale downwards
change platform
support organisational change
support new channel
alter business rules / parameters
maintain hardware
add new interface
exploit new technology
Maintainability
Flexibility / Extensibility

Ask: what's covered in the maintenance contract?

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

Challenges from the definition of ‘Flexibility’

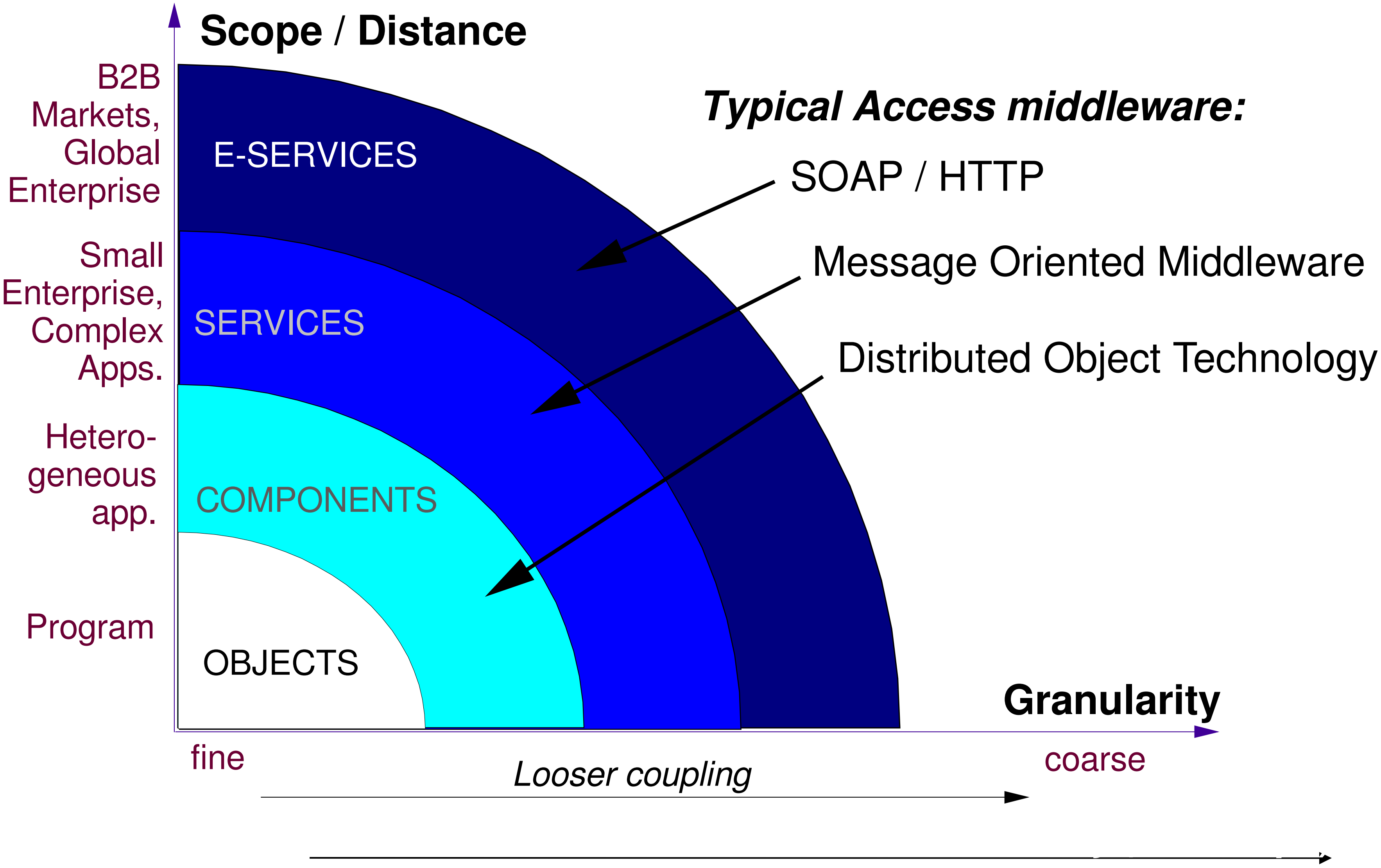
- Flexibility:
  - “The degree to which ..
  - .. a system can be changed or extended ..
  - .. to meet new or altered business requirements ..
  - .. with minimum cost, effort and impact to operations.”

- 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 efficiently

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 (! / ?)

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

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

Summary

Summary of Topics

- Despite continuing advances in technology, IT Architects spend significant amounts of time engineering IT systems to account for Qualities and Constraints
  - Software and infrastructure designs need to be iterated together to achieve goals
- IT systems increasingly go hand in glove with business processes and business policy
- Security is a vital characteristic of any IT system managing valuable assets
- Customer requirements often include vague and difficult to measure statements such as “easy to extend”, “supports future business change”, “easy to maintain”
- IT Architects need to consider all of the following for each design challenge:
  - Motivation – Requirements – Technologies & Tools – Methods and Techniques – Architecture & Design – Implementation – Management and Change
- Regardless of the quality of design, the quality of implementation must be validated through testing
  - Architects must influence test strategy and planning

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