Government ICT Strategy

End User Device Programme

EUD Programme - Conceptual Framework

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(v1.0)

PRODUCT CONTROL SHEET

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CHANGE HISTORY

Version No.	Date	Details of Changes included in Update	Author(s)
0.1 (Draft)	March 2012	Initial draft for stakeholder and supplier review.	Richard Tinker Philip O'Hagan
0.2 (Draft)	March 2012	Updated following stakeholder and supplier review.	Richard Tinker Philip O'Hagan
1.0	April 2012	Released to stakeholders	Richard Tinker Philip O'Hagan

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CONTENTS

1 EXECUTIVE SUMMARY

The End User Device (EUD) Programme – Conceptual Framework is a deliverable of the EUD Programme and presents a multi-tier reference architecture and Solution Framework for End User Devices. The framework is introduced and the four levels of the framework are described:

- **Level 1: Overview** - is the top level of the framework into which components at lower framework levels fit, presenting a device-centric and centralised infrastructure view of EUD.
- **Level 2: Conceptual** - provides an additional level of detail describing the specific components that describe the scope of the EUD. This is the reference architecture for EUD, with each component defined, and an associated RACI matrix illustrating the team responsible for the component definition and solution guidelines from the overall ICT programme.
- **Level 3: Solution Guidelines** - provides EUD Solution Guidelines for suppliers and government departments to refer to at all phases of a transformation programme. Good practice guidelines and examples of EUD strategy compliant products and solutions are provided along with reference to industry analyst views of the products maturity, strengths and weaknesses.
- **Level 4: Specific Implementation Guidelines** – Level 4 details how the framework may be used to describe a specific technology implementation detailing the technology used and choices made for each component.

This is the EUD Framework Level 2 deliverable – Conceptual Framework and there will be a number of further releases. This document is the initial release and focuses on the framework levels 1 and 2. Levels 3 and 4 of the framework will be included in future document releases, scheduled for publication at the end of May and the end of July respectively.

This document is provided for adopters of the EUD strategy, and is intended for consumption by government departments in their procurement of EUD services, and by suppliers to ensure that any EUD-related services and solutions they propose are aligned to the framework.

2 DOCUMENT PURPOSE AND STRUCTURE

This End User Device (EUD) Programme – Conceptual Framework document is a deliverable of the EUD Programme and presents the Solution Framework guidelines associated with the End User Device Strategy [1]. An overview of the framework is available in presentation format in the End User Device Framework [2] PowerPoint presentation.

This document addresses the requirements of the End User Device Programme, described in the EUD Programme Vision Statement [3]. The following end-goals of the vision are relevant to this document:

- Implementation of new end user devices will be the responsibility of individual departments as will delivery of the realisable benefits. Departments will be required to demonstrate that their overall technical approach is aligned to the vision and all major changes to end user devices are based on the new architectures and standards.
- Wherever possible, public sector workers should be able to access the services they need to carry out their job from any location, on any suitable government or non-government end user device.
- Deliver a minimum set of standards (to include characteristics and definitions) for end user devices and their use within government, taking into account service management and security requirements.

The EUD Framework provides a structure and solution guidelines that can be associated with components, which are described later in this introduction. This document provides a solution framework for adopters of the EUD strategy. What follows is a list of potential components for implementation as well as combinations which are not currently feasible (with the appropriate rationale).

2.1 INTENDED AUDIENCE

The intended audience for this Conceptual Framework document are senior executives and policy makers within the following organisations:

- Government Departments - Government Departments should use document to guide their ICT project and procurement activities, so it can be demonstrated that their overall technical approach is aligned to the vision and all major changes to end user devices are based on the EUD Solution Framework.
- Suppliers – Suppliers should use the document to ensure that any EUD-related services and solution they propose are aligned to the EUD Solution Framework.

The level 3 (Solution Guidelines) and level 4 (Specific Implementation Guidelines) will be written with intended audiences of solution/technical architects within government departments and suppliers.

2.2 DOCUMENT STRUCTURE

The document is structured such that:

- Section 1 is the executive summary of the End User Device Solution Framework
- Section 2 is this introduction
- Section 3 describes the EUD framework itself, the various levels and how it can be used to present recommended use cases.
- Section 4 details the level 2 framework information split into two sections: a device focused view of recommended use cases, highlighting recommended and non-recommended device usage and a Business Usage Segment View. For each of the 6 baseline business user roles the framework is used to present the recommended use cases. For each Business usage pattern the typical recommended device or devices usages are provided using the framework to describe each.
- Section 5 gives an overview of the future level 3 Solution Guidelines deliverable
- Section 6 gives an overview of the future level 4 Specific Implementation Guidelines deliverable
- Section 7 gives an overview of the future Journey Planning deliverable
- Section 8 gives an overview of the future BYOD Considerations deliverable

2.3 DOCUMENT RELEASE SCHEDULE

The EUD Programme will issue these documents in a series of steps. Levels 3 and 4 of the framework, Journey Planning and BYOD Considerations will be included in future document releases, scheduled for publication at the end of May and the end of July respectively.

3 Framework Guide

3.1 Introduction

The End User Device (EUD) Framework presents a multi-level reference architecture framework. The purpose of the framework is to:

- Identify the components under consideration by the EUD programme
- Provide a definition for each component within the framework. This definition is contained in the "EUD Component Definition and RACI Matrix" [4].
- Identify the stream, within the overall ICT programme, responsible for each component to aid the development of individual guiding principles and technical standards. This is defined in the "EUD Component Definition and RACI Matrix" [4].
- Provide a mechanism to associate business user segments, with end-user devices, desktop and application technologies and recommend optimum use cases.

3.2 Framework Lightboard Description

The Framework can be used to visually illustrate specific End-User Device implementation scenarios. To illustrate this, some patterns are applied to the framework components.

- **Highlighted Component** – Illustrates a component that is not only compatible with the scenario but is also a ***recommended*** component. This is a solution that is best suited to the scenario.
- **Visible Components** – Illustrate a component that is ***compatible*** with the scenario. The visible components show what is technically possible with the scenario.
- **Greyed Out Components** – Illustrate a component that is ***incompatible*** with the scenario. These can be considered blocked routes. As such the component is not relevant for the presented scenario.

When the following patterns are applied to the framework, the term 'Lightboard' is used.

FIGURE 1 - FRAMEWORK COMPONENT LIGHTBOARD KEY

3.3 Framework Views

The following are two key ways in which the framework can be used to illustrate scenarios.

- **Device Focused View** - The Device Focused Scenarios start with each Device Type in the device tier of the framework. The key is used to show the incompatible, compatible and recommended use cases for the given device.
- **Business Usage Segments Focused View** – The Business User Role Focused view presents High Level Business usage segments which illustrate the end-user devices available to

support the user role, and show incompatible, compatible and recommended use cases for the given Business User Role.

The EUD Framework is split into different levels; each level providing an increasing amount of detail. There are four framework levels.

3.4 Framework Level 1: Overview Level

The first level of the EUD Framework (Overview Level) is the top level of the framework and is broken down into two views

- **Device Centric View** – This view focuses on end-user devices themselves, but also shows the interaction with users along with the supporting pillars of Support & Management, Security and Connectivity
- **Centralised Infrastructure View** – This view focuses on the centralised infrastructure required to support end-user devices. Specifically this presents the data centre components required to deliver desktops and applications to end user devices, manage those devices. The supporting pillars of Support & Management, Security and Connectivity also apply.

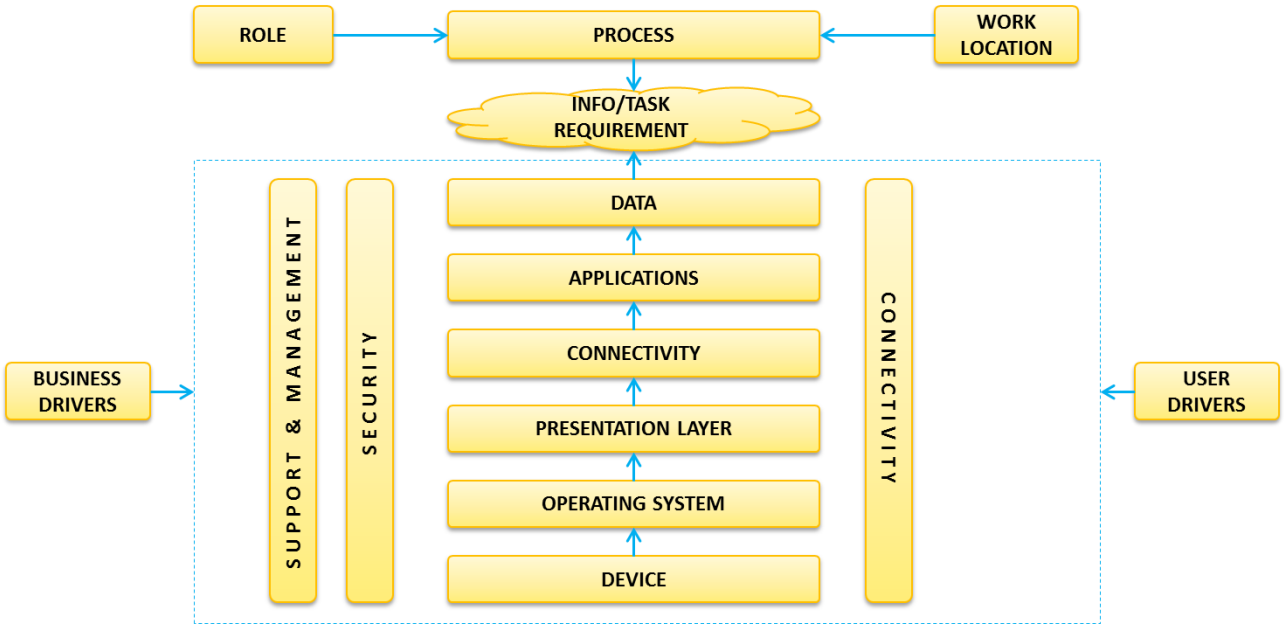

FIGURE 2– EUD FRAMEWORK LEVEL 1 (DEVICE CENTRIC VIEW)

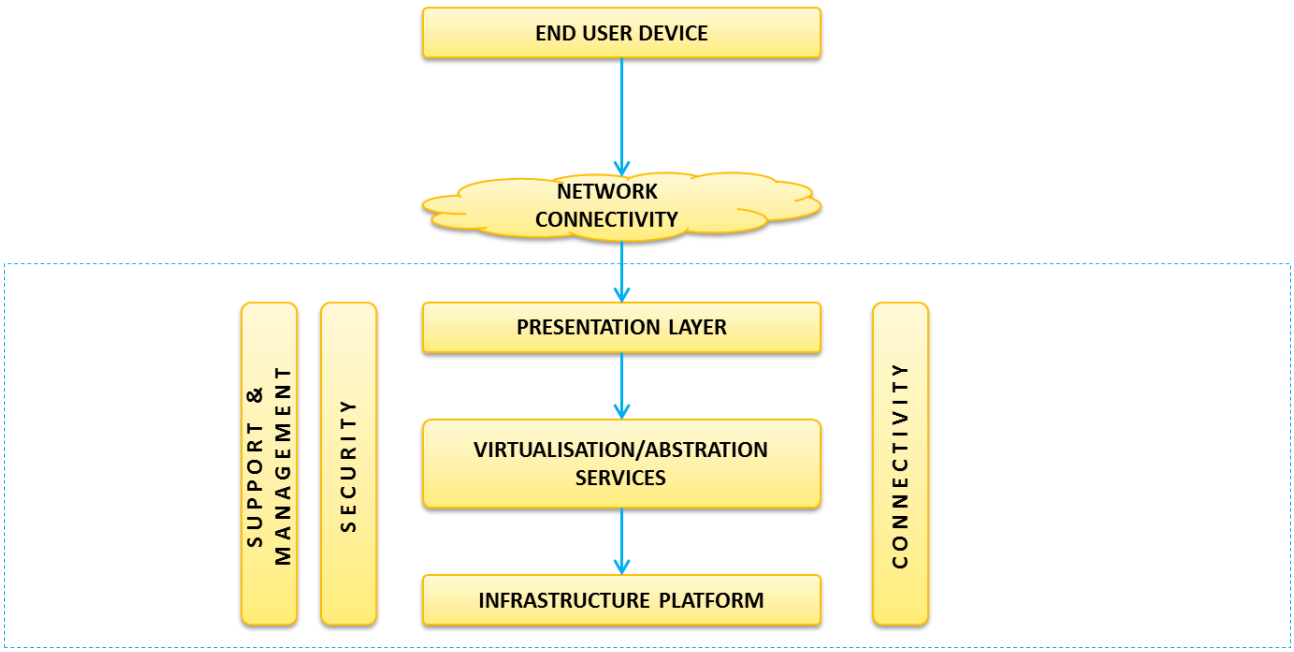

FIGURE 3 – EUD FRAMEWORK LEVEL 1 (CENTRALISED INFRASTRUCTURE VIEW)

Each component of the framework at level 1 is described in the associated document "EUD Component Definition and RACI Matrix" [4]. For example, the component 'Infrastructure Platform' is described as "*The infrastructure platform on which the centralised application, desktop and device management platforms are hosted. In the EUD Framework the Infrastructure Platform for Applications, Desktops and Device Management can be provided as a Cloud Service or a Private Cloud and is categorised as such.*"

Note that the supporting pillars are shown in both the Device Centric View and the Centralised Infrastructure View as these components apply across the framework. At level 1 these are defined as:

- Support and Management - The organisation and coordination of activities in accordance with policy, including support; a service for users who require technical assistance and/or problem resolution.
- Security - A means of protecting information and information systems from unauthorised access, use, disclosure, disruption, modification, perusal, inspection, recording or destruction
- Connectivity - The ability to connect between local information/data and that stored in an alternate location. This may include use of local networks or internet capabilities.

3.5 Framework Level 2: Conceptual Level Overview

The second level of the framework is the conceptual level. It provides an additional level of detail and describes end-user devices and their supporting centralised infrastructure components in terms of the components within each framework level 1 component.

The framework level 2 examines, at a conceptual level, the components of the framework, and discusses the key features of each component along with recommended modes of use.

At level 2 the framework is broken down into three sections

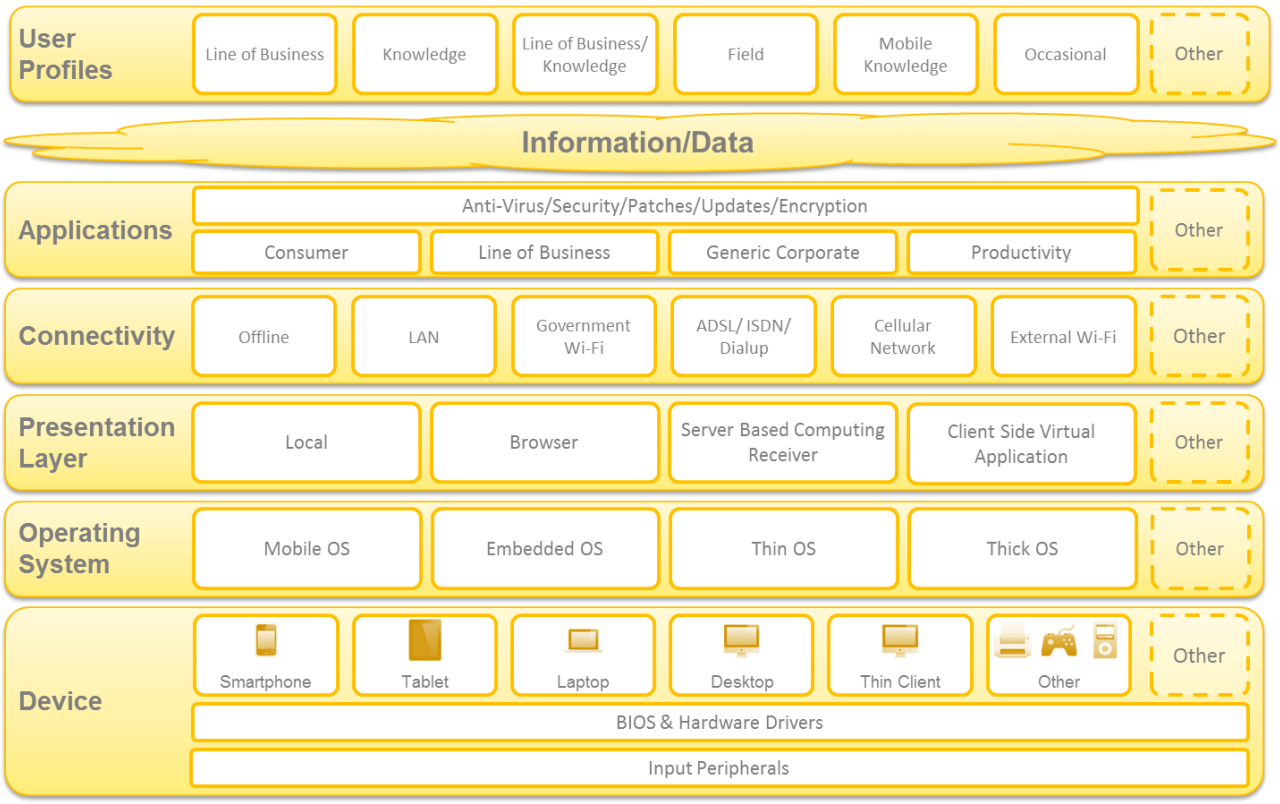

FIGURE 4 – EUD FRAMEWORK LEVEL 2 (DEVICE CENTRIC VIEW)

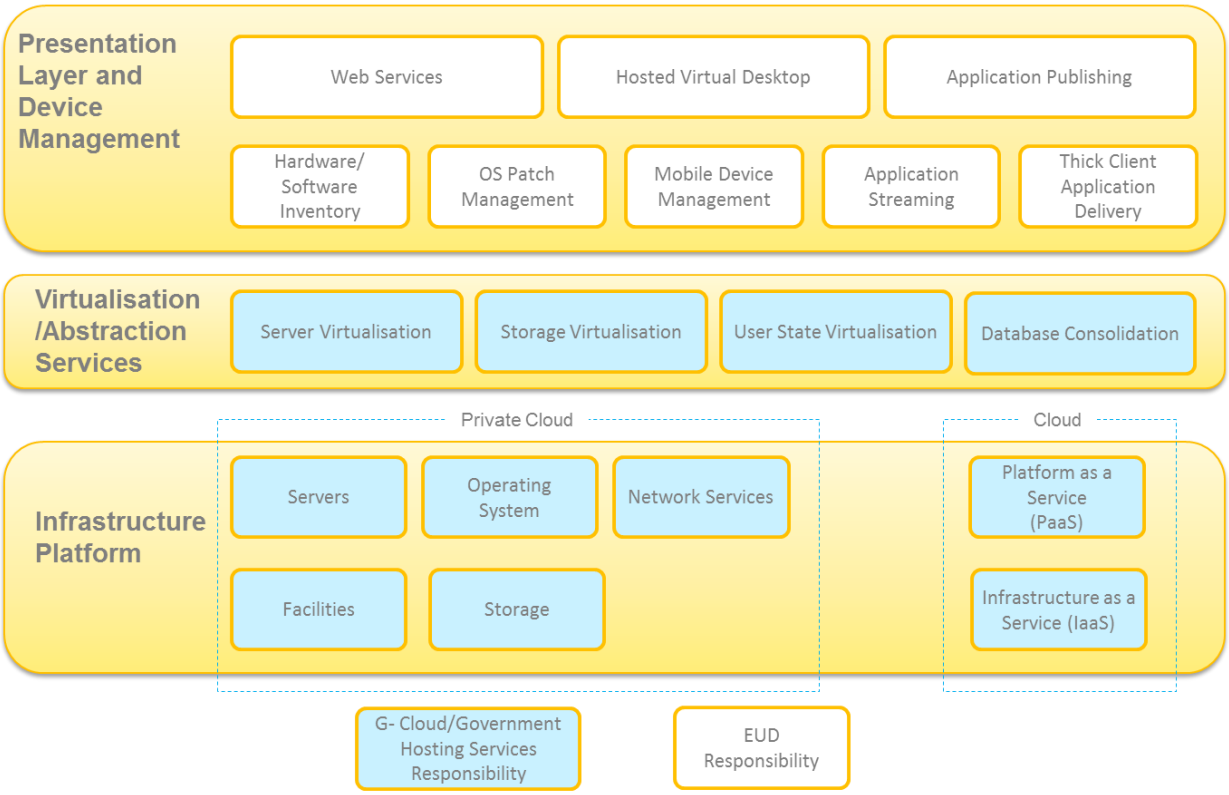

FIGURE 5– EUD FRAMEWORK LEVEL 2 (SERVER CENTRIC VIEW)

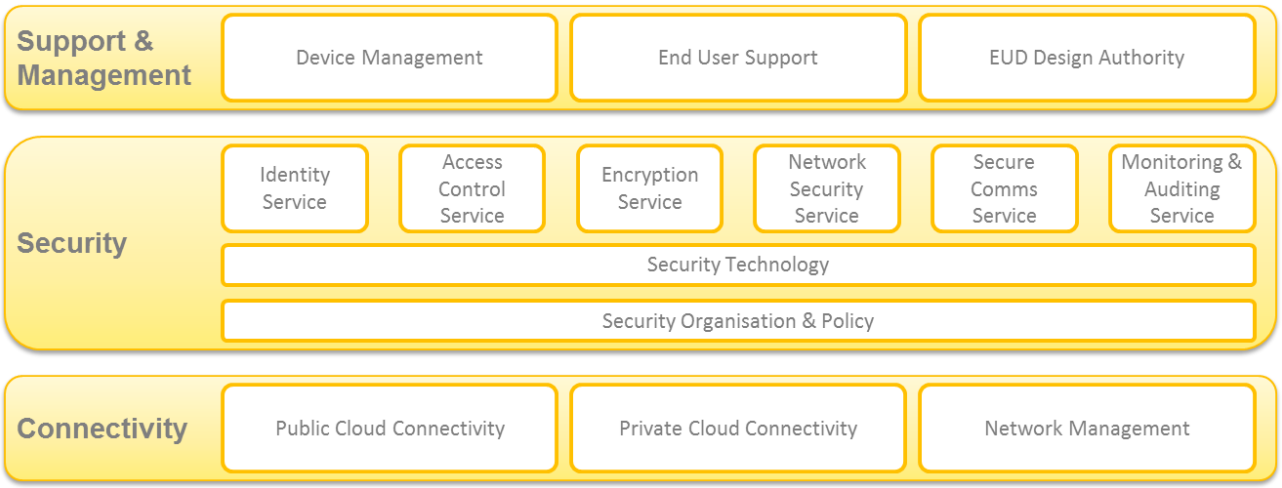

FIGURE 6 – EUD FRAMEWORK LEVEL 2 (SUPPORTING PILLARS)

3.6 Framework Level 3: Solution Guidelines Overview

The framework level 3 provides Solution Guidelines for suppliers and government departments to use during all phases of a transformation programme. The framework level 3 analyses each level 2 component, providing examples of product choices for this component and good practice guidelines with examples from other government organisations. For each component, we will refer to industry analysis giving details of the analyst's view of the products maturity, strengths and weaknesses.

3.7 Framework Level 4: Specific Implementation Guidelines Overview

At level 4, the framework will provide more detailed guidelines describing use of specific technologies and where possible providing examples of best practice from organisations who have already adopted that approach.

3.8 EUD Component Definition and RACI Matrix

The associated EUD Component Definition and RACI Matrix [4] have been created as part of the End User Device programme. In the document each component at level 2 is defined, along with the team responsible for the development of level 3 Solution Guidelines. The RACI matrix details the team responsible from the following involved teams:

- End User Device – led by HMRC
- G-Cloud – led by Ministry of Justice (MoJ)
- Government Hosting Consolidation – led by MoJ
- Public Service Network (PSN) – led by Ministry of Defence (MoD)

A sample extract from the RACI is shown below.

Example: Responsibility for Smartphone standards.

Component		Definition	EUD	GPS	G-Cloud	Government Hosting Services	PSN (inc. Cyber Security)	Organisations
End User Device Framework - Device Centric View								
Device			R, A	R	C	C	C	C
	Smartphone	A smartphone is a mobile phone built on a mobile computing platform, with more advanced computing ability and connectivity than a feature phone	A	R	C	C	C	C

FIGURE 7 – EUD RACI- SMARTPHONE EXAMPLE

For the component *Device -> Smartphone devices*, the EUD team is responsible for the development of the guiding principles and standards, and are also the Accountable team. The G-Cloud, Government Hosting Services and PSN teams will be consulted on the standards.

4 Framework Level 2: Conceptual Level

4.1 Introduction

Level 2 of the framework is the conceptual level. It provides an additional level of detail compared to level 1 and describes end-user devices and their supporting centralised infrastructure components based on each framework level 1 component. Level 2 also outlines usage segments based on application usage and interaction, mobility requirements and usage frequency.

Each of these elements is considered in turn, starting with the usage segments followed by the enabling components and finally the various end user devices.

All roles and device profiles are currently subject to change based upon the outcomes of the Government Protective Marking Scheme review.

4.2 Business Usage Segment Introduction

The Business Usage Segments view defines the High-Level Business Usage Patterns and illustrates the end-user devices available to support the user role. It also shows incompatible, compatible and recommended use cases for the given Business User Role.

Business Usage Focused Views use the EUD framework to give a view from the perspective of an end-user.

Important Note

A given user may utilise a range of devices in order to complete their work, and this can be reflected by using more than one EUD framework lightboard to illustrate the recommended use cases for each device.

4.2.1 Baseline User Segmentation

User segments are based upon the primary way that users need to use their IT order to do their jobs, according to the following criteria:

- Application usage
- Location and mobility requirements
- Usage frequency pattern
- Application interaction type

4.2.1.1 Application Usage

FIGURE 9- BASELINE USAGE SEGMENTS- APPLICATION USAGE

The application usage profile is based upon the kinds of applications an employee needs to use in order to do their job.

Application profile	Application types	Task types
Line of Business	• Line of Business[1] and specialist applications • Limited productivity tools with basic functionality, such as email, calendar, word processing, spread sheets and document storage. • Intranet and internet • Generic corporate systems[2]	Chiefly uses their IT for a small range of tightly-defined business processes using Line of Business systems
Knowledge	• Full suite of advanced functionality productivity tools, including email, calendar, spread sheets, presentations, word processing, document storage, collaboration etc. May also require ad hoc off the shelf tools e.g. project management software • Intranet and internet • Generic corporate systems • Limited or no reliance on Line of Business and specialist applications	Uses their IT for wide range of business processes. Can perform most, or all, of their core activities using generic IT tools and applications to consume and create documents, communicate, collaborate etc. Often referred to as a 'knowledge worker'
Line of Business & Knowledge	• Line of Business and specialist applications • Basic functionality productivity tools such as email, calendar, spread sheets, presentation software, word processing and document storage. • Intranet and internet • Generic corporate systems	Uses their IT for a range of business processes, with a balance of document creation and direct access to Line of Business systems
Generic Corporate	• Generic corporate systems • May require some access to email internet or intranet.	Does not rely on IT for core activities (but may need occasional access for supporting tasks)

[1] **Line of Business Applications**- A set of critical computer applications perceived as vital to running a given business area.

[2] **Generic Corporate Systems** refers to those services generic to the organisation which all employees need some access to, such as HR systems for booking leave, claiming travel expenses etc.

4.2.1.2 Location and Mobility

FIGURE 10- BASELINE USAGE SEGMENTS- LOCATION AND MOBILITY

Location and mobility requirements are categorised according to where the user needs access to services to carry out their job:

- **Trusted Location** - direct access to services from a trusted network in a government location, such as a fixed workstation within an office. This includes connection by government WiFi directly onto a restricted network. In line with EUD principles to provide access across multiple devices, this also includes desk sharing (or hot-desking) by default.
- **Remote** - access to services from remote locations from an untrusted network, such as from an ordinary home internet connection. This includes connection via WiFi over the internet.
- **Mobile** - access to services while fully mobile and in the field. This includes the ability to use applications offline as required.

In practical terms, it is assumed that a fully mobile requirement also encompasses a remote requirement. Similarly, if a user is able to work remotely, it is assumed by default that they should be able to access the same services from a trusted location.

4.2.1.3 Usage frequency

FIGURE 11- BASELINE USAGE SEGMENTS- USAGE FREQUENCY

- **Sustained** - access to services for prolonged periods throughout their working day or shift.
- **Intermittent** - access to services for short periods of time (commonly a single task) throughout their working day as part of core activities.
- **Infrequent** - occasional access to a service or services.

4.2.1.4 Application interaction type

FIGURE 12- BASELINE USAGE SEGMENTS- APPLICATION INTERACTION TYPE

- **Create -** create new content as well as view or alter existing content.
- **Manage** – alter existing content as well as view.
- **Consume** – view or read only

4.2.2 Example Baseline User Segments

Commonly found patterns are outlined below to describe example baseline user segments. As part of an organisations' transformation project, an important first activity is to develop the baseline user segments for your organisation. The labels found below are arbitrary and could apply to a range of job roles.

4.2.2.1 Line of Business User

Chiefly characterises users who perform a small number of dedicated processing tasks from a trusted location, such as users who work as contact centre operatives and back office processing roles.

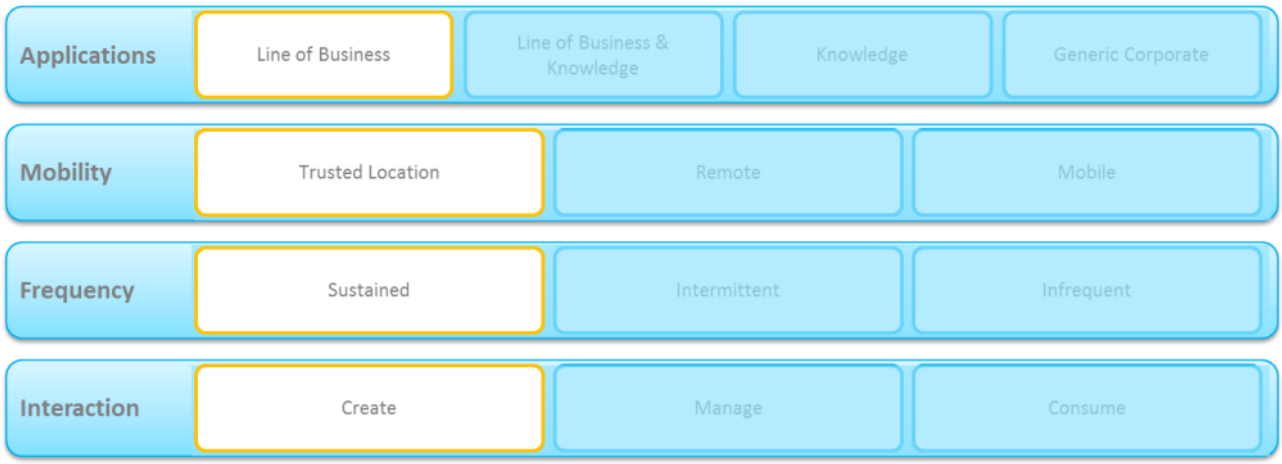

FIGURE 13- EXAMPLE BASELINE USAGE SEGMENTS- LINE OF BUSINESS USER

Based on the High-Level baseline user segment for a Line of Business User, it is likely that one device will be utilised:

- Desktop based lightboard

4.2.2.1.1 Desktop

It is suggested that a desktop is the primary device issued to a Line of Business User given their application needs, their expected use cases for these applications as well as the constant location required by their usage. Given the information presented in section 4.4.1 Device: Desktop this desktop is likely to take the following configuration:

- Device: Government Procurement Service specification desktop or thin client
- Operating System: Thick Operating System
- Connectivity: LAN connectivity
- Presentation Layer/Applications: Line of Business Applications-Web based/Server Based Computer Receiver; Productivity Applications- Client Side Virtual Applications

4.2.2.2 KNOWLEDGE USER

Knowledge workers primarily use rich productivity tools from fixed locations (such as an office), for example policy workers, managers etc.

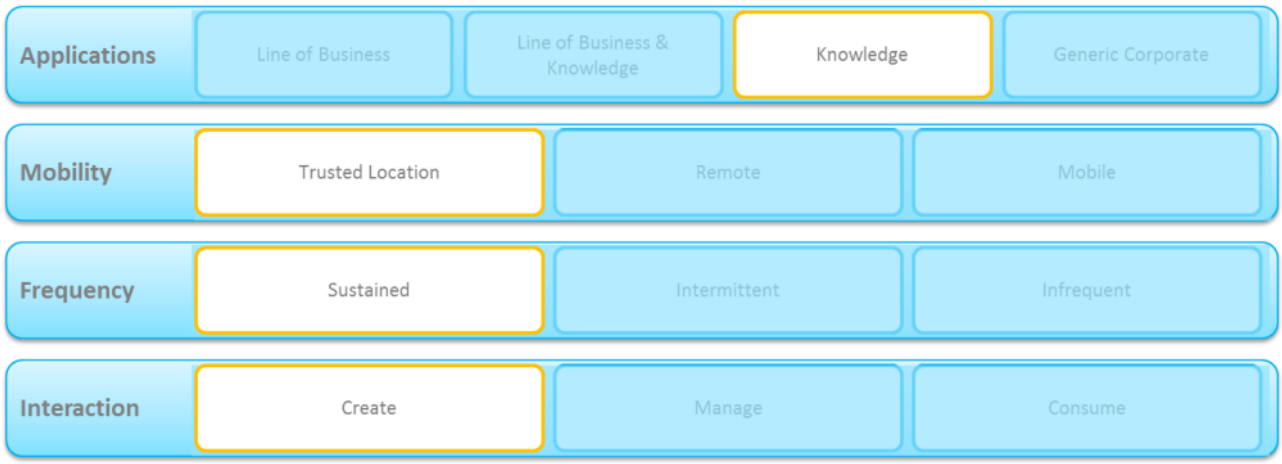

FIGURE 14- EXAMPLE BASELINE USAGE SEGMENTS- KNOWLEDGE USER

Based on the High-Level baseline user segment for a Knowledge User, one scenario is that a user may need two devices:

- A Desktop based lightboard when working in the office
- A Smartphone based lightboard to provide additional flexibility and productivity

4.2.2.2.1 DESKTOP

A desktop is likely to be the primary device issued to a Knowledge User given their application needs, their expected use cases for these applications as well as the constant location required by their usage pattern. This desktop is likely to take the following configuration (see also section 4.4):

- Device: Government Procurement Service specification desktop or thin client
- Operating System: Thick Operating System
- Connectivity: LAN connectivity
- Presentation Layer/Applications: Line of Business Applications-Web based/Server Based Computer Receiver; Productivity Applications- Client Side Virtual Applications

4.2.2.2.2 SMARTPHONE

A Knowledge Worker might additionally receive a smartphone as a secondary device given their application needs, their expected use cases and the flexibility required by their role. This smartphone is likely to take the following configuration (see also section 4.4 Device Focused View):

- Device: Government Procurement Service specification smartphone
- Operating System: Mobile Operating System
- Connectivity: Internal 3G/GPRS
- Presentation Layer/Applications: Productivity Applications- Local; Line of Business Applications- not accessible

4.2.2.3 Line of Business/Knowledge User

This section describes those hybrid users who balance their IT usage between Line of Business systems and creating documents or manipulating data with productivity tools, from a fixed location or locations (commonly an office or offices). These might be caseworkers, line of business managers etc.

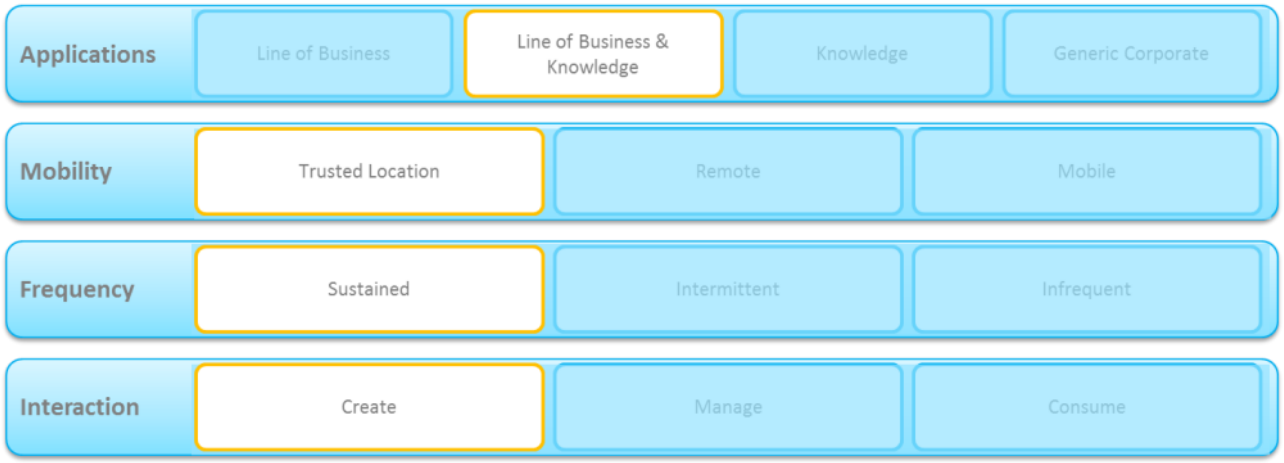

FIGURE 15- EXAMPLE BASELINE USAGE SEGMENTS- LINE OF BUSINESS/KNOWLEDGE USER

Based on the High-Level baseline user segment for a hybrid user, one scenario is that a typical user may need two devices:

- Desktop based lightboard
- Smartphone based lightboard

4.2.2.3.1 Desktop

A desktop is likely to be the primary device issued to a hybrid user given their application needs, their expected use of these applications and their location. This desktop is likely to take the following configuration:

- Device: Government Procurement Service specification desktop or thin client
- Operating System: Thick Operating System
- Connectivity: LAN connectivity
- Presentation Layer/Applications: Line of Business Applications-Web based/Server Based Computer Receiver; Productivity Applications- Client Side Virtual Applications

4.2.2.3.2 Smartphone

A hybrid user may additionally receive a smartphone as a secondary device given their application needs, their use and the flexibility required by their role. This smartphone is likely to take the following configuration:

- Device: Government Procurement Service specification smartphone
- Operating System: Mobile Operating System
- Connectivity: Internal 3G/GPRS
- Presentation Layer/Applications: Productivity Applications- Local; Line of Business Applications- not accessible

4.2.2.4 Field User

A Field User needs access to a balance of Line of Business and productivity applications which are available on the move (including offline). A Field User might be a visiting officer, investigator or caseworker who needs to access or update customer records offline, as well as create documents and manipulate data.

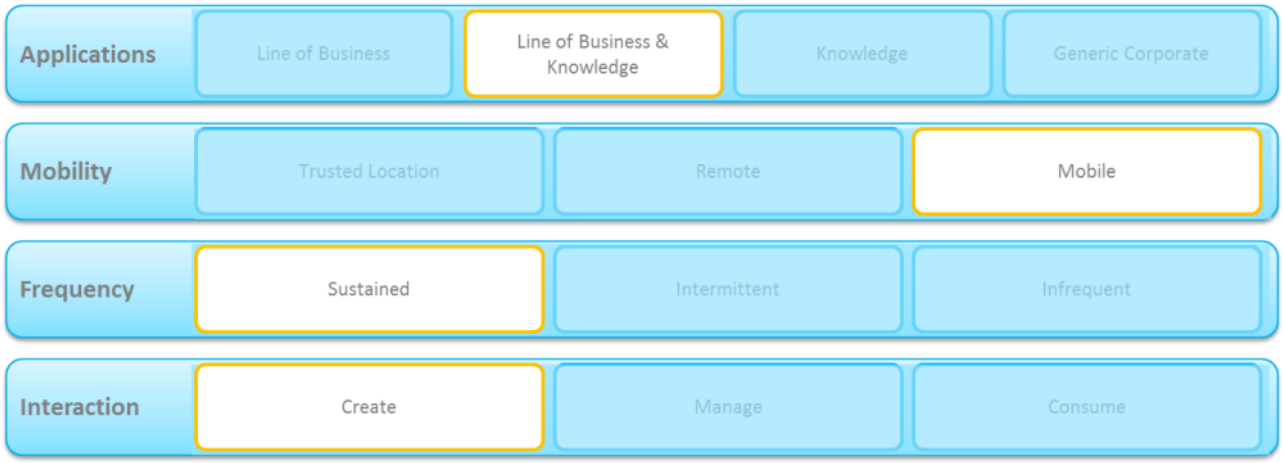

FIGURE 16- EXAMPLE BASELINE USAGE SEGMENTS- FIELD USER

Based on the High-Level baseline user segment, a Field User might use two from the following three devices:

- Laptop based lightboard
- Smartphone based lightboard
- Tablet based lightboard

4.2.2.4.1 Laptop

A laptop is likely to be the primary device issued to a Field User given their application needs, their expected use of these applications as well as the need for location flexibility. This laptop is likely to take the following configuration:

- Device: Government Procurement Service specification regular laptop
- Operating System: Thick Operating System
- Connectivity: LAN/ Internal WiFi when in an office location, WiFi or External 3G when remote
- Presentation Layer/Applications: Line of Business Applications-Web based; Productivity Applications- Client Side Virtual Applications

4.2.2.4.2 Smartphone Or Tablet

It is likely that a Field User might additionally use a secondary device to provide additional flexibility required by their usage pattern. This is likely to be either a smartphone or a tablet.

If a smartphone is used as the secondary device it is likely to take the following configuration:

- Device: Government Procurement Service specification smartphone
- Operating System: Mobile Operating System
- Connectivity: Internal 3G/GPRS

- Presentation Layer/Applications: Productivity Applications- Local; Line of Business Applications- not accessible

If a tablet is used as the secondary device it is likely to take the following configuration:

- Device: Government Procurement Service specification smartphone
- Operating System: Mobile Operating System
- Connectivity: Internal 3G/GPRS or External WiFi
- Presentation Layer/Applications: Productivity Applications- Local; Line of Business Applications- not accessible

4.2.2.5 Mobile Knowledge User

These are pure 'knowledge workers' who use generic productivity tools to perform core activities on the move (including offline). They have little or no reliance on Line of Business applications. This group might include internal advisors, consultants or senior managers.

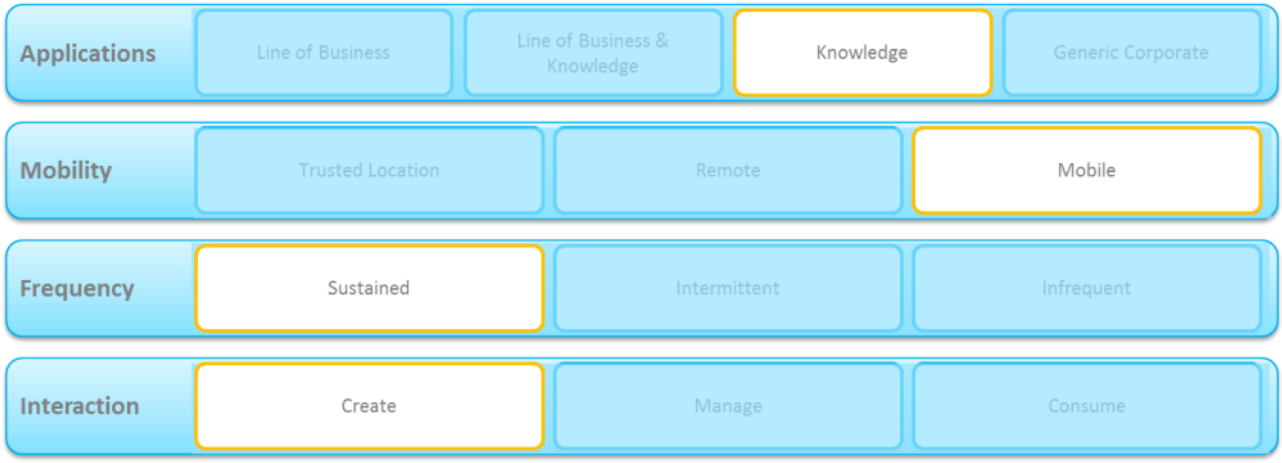

FIGURE 17- EXAMPLE BASELINE USAGE SEGMENTS- MOBILE KNOWLEDGE USER

Based on the High-Level baseline user segment, a Mobile Knowledge User two ranges of devices from the following three might be used:

- Laptop based lightboard
- Smartphone based lightboard
- Tablet based lightboard

4.2.2.5.1 Laptop

A laptop is likely to be the primary device issued to a Mobile Knowledge User given their application needs, their use of these applications and the need for location flexibility. This laptop is likely to take the following configuration:

- Device: Government Procurement Service specification regular laptop
- Operating System: Thick Operating System
- Connectivity: LAN/ Government WiFi when in an office location, WiFi or External 3G when remote
- Presentation Layer/Applications: Line of Business Applications-Web based; Productivity Applications- Client Side Virtual Applications

4.2.2.5.2 Smartphone Or Tablet

It is likely that a Mobile Knowledge Worker might additionally use a secondary device to provide additional flexibility required by their usage pattern. This is likely to be either a smartphone or a tablet.

If a smartphone is used as the secondary device it is likely to take the following configuration:

- Device: Government Procurement Service specification smartphone
- Operating System: Mobile Operating System
- Connectivity: Internal 3G/GPRS
- Presentation Layer/Applications: Productivity Applications- Local; Line of Business Applications- not accessible

If a tablet is used as the secondary device it is likely to take the following configuration:

- Device: Government Procurement Service specification smartphone
- Operating System: Mobile Operating System
- Connectivity: Internal 3G/GPRS or External WiFi
- Presentation Layer/Applications: Productivity Applications- Local; Line of Business Applications- not accessible

4.2.2.6 Occasional User

An Occasional User does not use IT for their primary tasks, but may occasionally need to access a system to perform a supporting task, such as view their payslip or book annual leave etc.

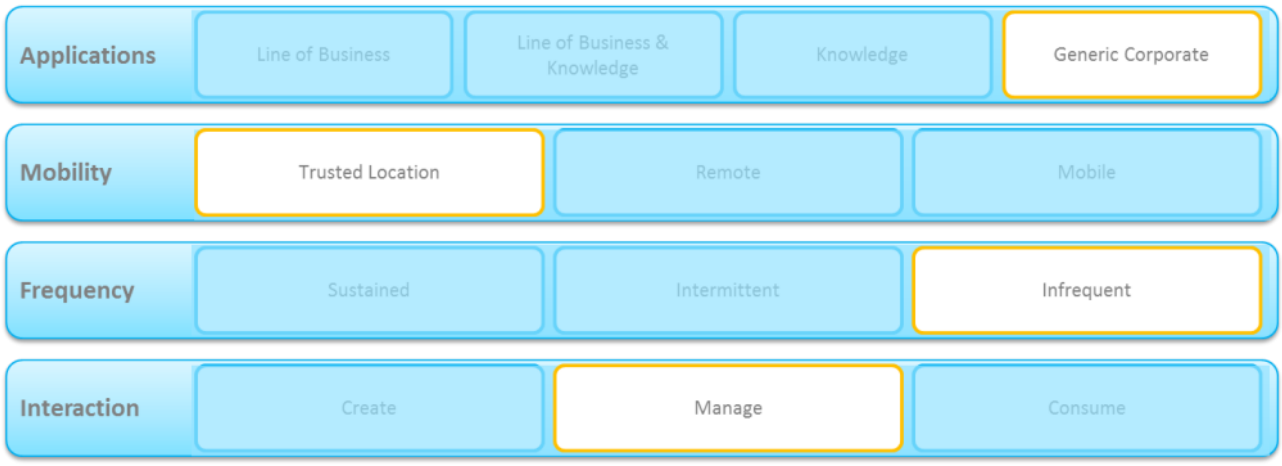

FIGURE 18- EXAMPLE BASELINE USAGE SEGMENTS- OCCASIONAL USER

Based on the High-Level baseline user segment an Occasional User is likely to need a single device:

- Shared Desktop based lightboard

4.2.2.6.1 Shared Desktop

A desktop is likely to be the primary device used by an Occasional User given their application needs, and expected use as well as the locations required by their usage pattern. This desktop machine is likely to be shared between several occasional users for access to Generic Corporate systems. This desktop is likely to take the following configuration:

- Device: Government Procurement Service specification desktop or thin client
- Operating System: Thick Operating System
- Connectivity: LAN connectivity
- Presentation Layer/Applications: Line of Business Applications-Web based/Server Based Computer Receiver; Productivity Applications- No requirement.

4.3 Component Introduction

The following sections outline the key elements in the Level 2 Framework.

4.3.1 Applications Introduction

The Level 2 Framework groups most applications into 4 distinct categories:

- **Consumer**- Consumer Applications are available on Applications Markets that are intended for individuals as opposed to organisations or institutions. These, in general, do not form a part of the user's work-related activities. Examples include mobile browsing, money transfer, music or social networking applications.
- **Line of Business**- A set of critical computer applications perceived as vital to running a given business area.
- **Generic Corporate Systems** refers to those services generic to the organisation which all employees need some access to, such as HR systems for booking leave, claiming travel expenses etc.
- **Productivity**- An application that is common to most computers in your organisation and used primarily by knowledge workers, such as an Office suite or Browser.

4.3.2 Connectivity Introduction

The Level 2 framework describes potential connectivity routes for each device and user. These are defined as follows:

- **Offline**- Defines the device operating without any form of connection to the internet, intranet or other devices.
- **LAN**- Wired LAN Wired Ethernet connectivity to PSN on Government premises.
- **Government WiFi**- Internal wireless Ethernet connectivity in the company premises.
- **ADSL/ ISDN/ Dialup**- Connectivity to the internet or the company network over the public telephone network.
- **Cellular Network**- Connection to the internet via non-Government, publicly available mobile phone networks.
- **External WiFi**- Access through WiFi hotspot networks, normally in a public location such as a cafe

4.3.3 Presentation Layer Introduction

4.3.3.1 Local Application

4.3.3.1.1 Definition and Description

The EUD Framework component definition for 'Local' is "The application or program is accessed as part of the operating system, or installed onto the operating system. An application installed onto the operating system is called thick-client application."

Local Applications (sometimes referred to as native applications) have been a method of application delivery for computers, since the first use of desktop computing. All of the operating system

platforms for end-user devices support the use of local applications, either those that come as part of the Operating System (OS), or installed as applications onto the Operating System.

With the exception of applications provided as part of the OS, local applications need to be installed onto the OS. The methods available for installation are:

- **Manual application installation** – Involves user interaction with the device to install the application. An example of manual install would be a user obtaining software on a DVD and using a local DVD drive on a desktop computer running a Thick OS to install application software onto the computer.
- **Managed application installation** – Applications are installed to end-user devices using a device management infrastructure. An example of a managed application installation would be using Client Systems Management Product to initiate an application install using a packaged application to a desktop PC running a Thick OS. The PC to which the application is installed is managed by the device management infrastructure. Where there is a public or private Application Store associated with the device and OS, the application is downloaded and installed to the device from the Application Store.

The following lightboard shows the Presentation Layer and Device Management components associated with local applications. 'OS Patch Management' is included, as this service provides updates for the underlying OS including applications included in the OS. Hardware/Software inventory is a closely related service and is often delivered using the same toolset that is used for the other components.

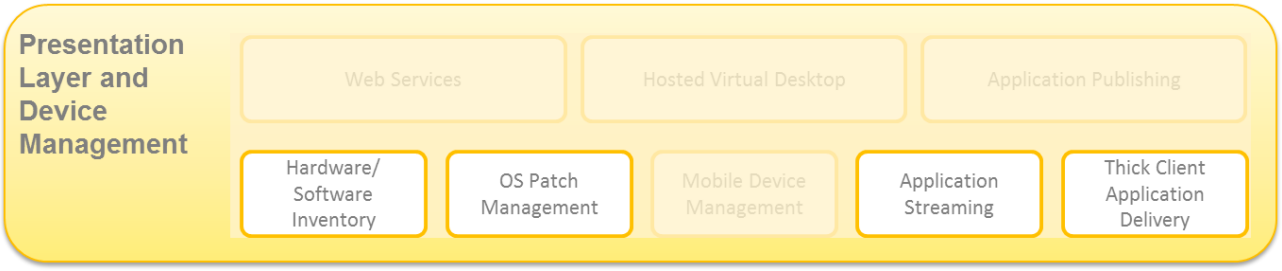

FIGURE 19 - PRESENTATION LAYER AND DEVICE MANAGEMENT LIGHTBOARD FOR LOCAL APPLICATIONS

From a framework perspective using a vendor Application Store to select and download an application to a tablet device is an application is covered by Thick Client Application Delivery as the application delivered is installed locally onto the device.

4.3.3.1.2 ADVANTAGES AND DISADVANTAGES

Local applications have the following benefits

- **Portability and Offline Use** – Applications are installed locally on the end-user device, and can be used when not connected to network.
- **Rich User Experience** – Local applications run on end-user devices for which they are designed to be compatible. As such local applications often offer a good user experience, often better than those offered by other application delivery methods.

The following are the potential drawbacks of local application installation

- **Management and tracking** of applications and associated license usage is typically more complex than for browser, Server Based Computing and Virtual Applications. This is particularly apparent when the applications are manually installed rather than managed by a Client Systems Management toolset. Local applications can be installed on an end-user device within or outside of out in the corporate estate (sometimes by business users rather than IT), and management infrastructure is often required at local sites, whereas Server-Based and Virtual Applications are more typically managed centrally in one or two data centre locations.
- **Application interoperability constraints** – Local applications can generally interoperate which can be a benefit (e.g. data sharing between applications), however running local applications on the same platform can sometimes lead to application conflicts. Testing of groups of applications running on the same device and OS can be used to identify any conflicts (application interoperability testing).

4.3.3.2 Browser Application

[Section to be developed in conjunction with G-Cloud in order to align with G-Cloud web/browser standards]

4.3.3.2.1 Definition and Description

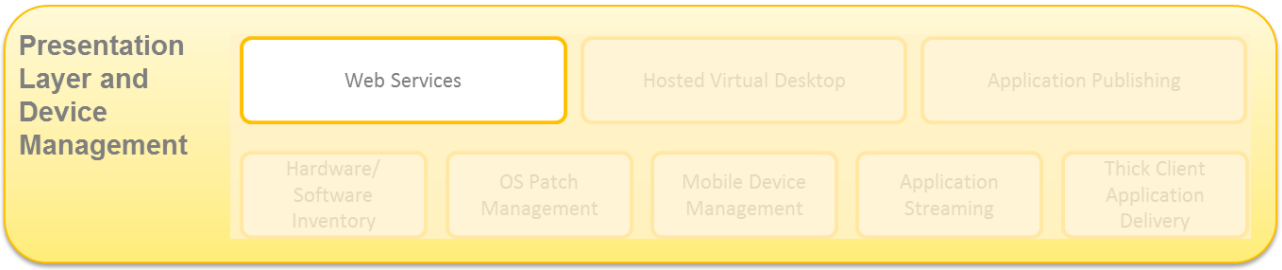

FIGURE 20 - PRESENTATION LAYER AND DEVICE MANAGEMENT LIGHTBOARD FOR BROWSER APPLICATIONS

4.3.3.2.2 Advantages and Disadvantages

To be defined.

4.3.3.3 Server Based Computing Receiver

4.3.3.3.1 Definition and Description

A Server Based Computing Receiver is the client side component of Server Based Computing delivery methods (e.g. Desktop and Application Publishing and Hosted Virtual Desktop). The client side component, sometimes called a Receiver or Player is installed on endpoint device (such as a PC Operating System or Thin Client Device) to receive a data stream from the server based computing component.

Server Based Computing Receivers are compatible with the two main methods of Application and Desktop delivery:

- **Hosted Virtual Desktop** - Hosted Virtual Desktop is a Server Based Computing desktop delivery model where desktop clients are hosted on a server virtualisation platform (Hypervisor) and made available to users using a Connection Broker. Desktops are made available to end user devices via the Connection Broker using a remoting protocol (thin client protocol)
- **Desktop and Application Publishing** – Desktop and Application Publishing is a Server Based Computing desktop and application delivery model where desktops and application are hosted on a server, and a shared session is used to deliver a desktop or application to an end user device using a remoting protocol.

The following lightboard shows the Presentation Layer and Device Management components associated with Server Based Computing Receiver applications.

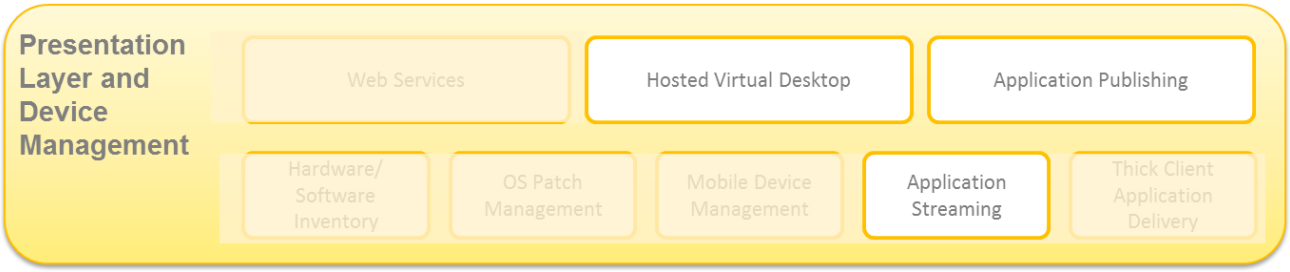

FIGURE 21 - PRESENTATION LAYER AND DEVICE MANAGEMENT LIGHTBOARD FOR SERVER BASED COMPUTING RECEIVER APPLICATIONS

Important Note

Application streaming is shown in the diagram as this technology can be used in the data centre to stream an application to a Remote Desktop Session Host Server (Terminal Server). The application is then published to a Server Baser Computing Receiver using a remoting protocol. Application Streaming is not used between the Remote Desktop Session Host Server and the Server Based Computing Receiver.

4.3.3.3.2 Advantages and Disadvantages

The following are recognised advantages of Server-Based Computing:

- **Centralised Management** – Server Based Computing Applications and Desktops are inherently easier to manage as they are located in a central place in a computer room or data centre, or a small number of locations when a Disaster Recovery implementation is used. The tools to manage the desktops and applications are centralised rather than distributed throughout the estate.
- **Increased Security** – Application execution and data are in the computer room or data centre. If a user loses a laptop, there are no concerns over data loss, encryption or backup as there is no data on the device. Additionally the data travelling over the network is simply

remoting protocol transmission of graphical screen elements, input device sequences and audio stream (where used).

- **Access from Anywhere** – Server Based Computing allows access from anywhere there is a network connection to the centralised infrastructure. Access to desktop and applications can be offered from any Government network, and it has the potential (subject to security approval) to allow access to desktops and applications from any Internet connected device.
- **Consistent performance** – Server Based Computing offers a way of delivering applications that would be slow over the WAN in a traditional client/server configuration. In a Server-Based Computing configuration, communication between back-end components is over a fast network in the data centre, with only the remitting protocol traffic traversing the WAN to the end-user device, offering the user much better application performance.

However there are also some disadvantages, limitations or considerations that should be taken into account for Server-Based Computing

- **No Offline Usage** – An obvious limitation of Server-based computing is that it is reliant on having a network connection.
- **Client Management Considerations** – As with thick client PCs, server-based computing desktops and applications need to be managed, and there are very similar considerations to be made around management tools, level of environment lock-down and approach to failure.
- **Graphical Application Limitations** – For highly-graphical applications, good bandwidth and available processing are factors that can influence the user experience. Careful consideration needs to be taken of these factors when designing a Server-Based Computing platform for such applications.
- **Client Peripherals** – If peripheral support (e.g. USB device) is required, then this has to be considered in the design of a Server-Based computing platform. Although Hosted Virtual Desktop and Desktop and Application Publishing solutions can support USB devices, depending on the specific products used, certain peripherals may not be supported (e.g. USB cameras) or certain standards (e.g. USB3).
- **Technical Complexity** – Server Based Computing infrastructures are inherently more complex in nature than 'traditional' thick client deployments, as a solution that delivers a good user experience to an end-user is dependent on an architecture comprising of well architected network, storage and data centre components (i.e. servers and hypervisors). The complexity of Server Based Computing environments, and an IT organisations ability to design, deliver and run such an environment needs to be considered for a new server-based computing environment.
- **Licencing** – Server Based Computing licencing is a complex area, and it is important that the licencing requirements for the various models are fully understood ahead of embarking on a project to ensure the environment is properly licenced and the costs of those licences are understood.

4.3.3.4 Client Side Virtual Application

4.3.3.4.1 Definition and Description

A Client Side Virtual Application is an application run on a client agent running on the endpoint device. The application is encapsulated in an isolated environment rather than running on the underlying operating system. . The client side virtual application is either run in a virtualisation client or the execution environment is part of the application.

The following lightboard shows the Presentation Layer and Device Management components associated with Client Side Virtual applications.

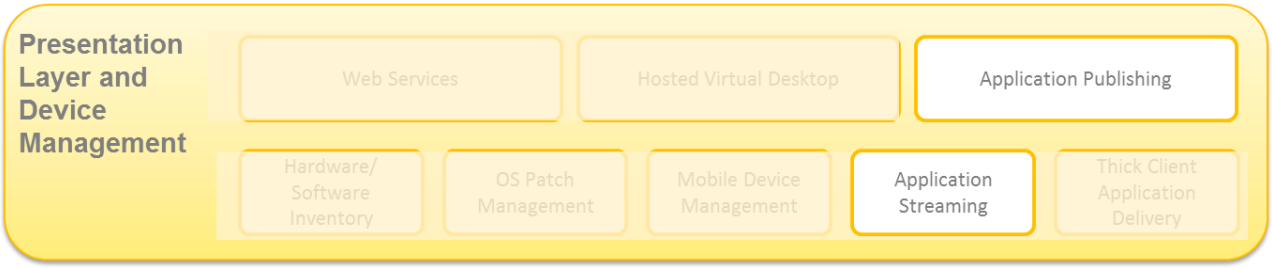

FIGURE 22 - PRESENTATION LAYER AND DEVICE MANAGEMENT LIGHTBOARD FOR CLIENT SIDE VIRTUAL APPLICATIONS

Important Note

Application publishing is shown in the diagram as this technology can be combined with application streaming in the data centre. Specifically an application can be streamed to a Remote Desktop Session Host Server (Terminal Server). A single virtualised application can be used to deliver applications to thick clients running a Client Side Virtual Application, and also to stream to a Remote Desktop Session Host Server (Terminal Server).

4.3.3.4.2 ADVANTAGES AND DISADVANTAGES

The following are recognised advantages of Application Virtualization:

- **Local Application Execution in Isolation** – virtualised applications can be used without changing the local operating system or installing application software at a particular end-point. The application can be executed as if it had been installed locally and can save data and print without the need of any modifications to the local client.
- **Reduce Application Testing** - Application compatibility testing is significantly reduced compared with standard local (native) application installation, and the applications are isolated from one another. This reduces application testing lifecycles.
- **Application Compatibility** – Virtual applications can deliver incompatible applications (i.e. different versions of Microsoft Access) to same end-point and both can be used without conflict.
- **Thick Client and Desktop and Application Publishing Support** - Application Virtualization can make applications available to desktops, laptops, Hosted Virtual Desktops and Remote Desktop Services Session Host (Terminal Services) platforms. The applications package required to deliver virtual applications (often called a sequenced app) can be used one for

both delivery platforms (i.e. an application can be sequenced once and used with Server Hosted Applications, Virtual Machine Hosted Applications, and as Local Applications)

However there are also some disadvantages, limitations or considerations that should be taken into account for virtual applications:

- **Application Compatibility** – Not all applications can be virtualised. Examples of such applications include:
  - Applications that are part of the Operating System (such as Browsers)
  - Applications that use COM+
  - Applications that require kernel-mode device drivers
  - Applications over 4GB in size once sequenced
  - Antivirus software
  - Applications that start services at boot time
  - Service packs and security fixes

4.3.4 Operating System Introduction

The conceptual framework seeks to identify the correct type of Operating System for each device. The categories of Operating Systems considered are:

- **Mobile OS-** A mobile operating system (Mobile OS) is the operating system that controls a smartphone, tablet, PDA, or other mobile device. Modern mobile operating systems combine the features of a personal computer operating system with touchscreen, cellular, Bluetooth, WiFi, GPS mobile navigation, camera, video camera, speech recognition, voice recorder, music player, near field communication, personal digital assistant (PDA), and other features.
- **Embedded OS**- An embedded operating system (Embedded OS) is an operating system for embedded computer systems. These operating systems are designed to be compact, efficient, and reliable, forsaking many functions that non-embedded computer operating systems provide, and which may not be used by the specialized applications they run. They are frequently also real-time operating systems, and the term RTOS is often used as a synonym for embedded operating system. An important difference between most embedded operating systems and desktop operating systems is that the application, including the operating system, is usually statically linked together into a single executable image. Unlike a desktop operating system, the embedded operating system does not load and execute applications. This means that the system is only able to run a single application.
- **Thin OS**- A Thin OS is an Operating System that runs on a Thin Client Device, or an operating system that is installed on a thick-client device in order to re-purpose it as a thin client.
- **Thick OS**- A Thick OS is an Operating System than runs on a Thick-Client Device (e.g. a laptop or a desktop).

4.4 DEVICE FOCUSED VIEW

The Device Focused Views provide guidelines relating to defined device components; illustrating the incompatible, compatible and recommended use cases for the given device. We have looked at devices based on numbers in use in the current government estate. For each device type, the recommended use cases are discussed, and key considerations provided relating to

- Operating System
- Presentation Layer
- Connectivity
- Applications

In recent years, the marketplace has converged capabilities and applications across multiple form factors, e.g. a traditional thick OS may runs on a both a laptop/desktop and also a tablet whilst another tablet may use Smartphone operating systems. This blurring of technology poses issues in creating simple frameworks to define probable solutions. The EUD framework considers a device purely on its form factor, regardless of the operating system installed.

4.4.1 Device: Desktop

A desktop computer is a personal computer (PC) in a form intended for regular use at a single location, as opposed to a mobile laptop or portable computer. Early desktop computers are designed to lay flat on the desk, while modern towers stand upright. Most modern desktop computers have separate screens and keyboards.

The following lightboard shows the incompatible, compatible and recommended use cases for a desktop device.

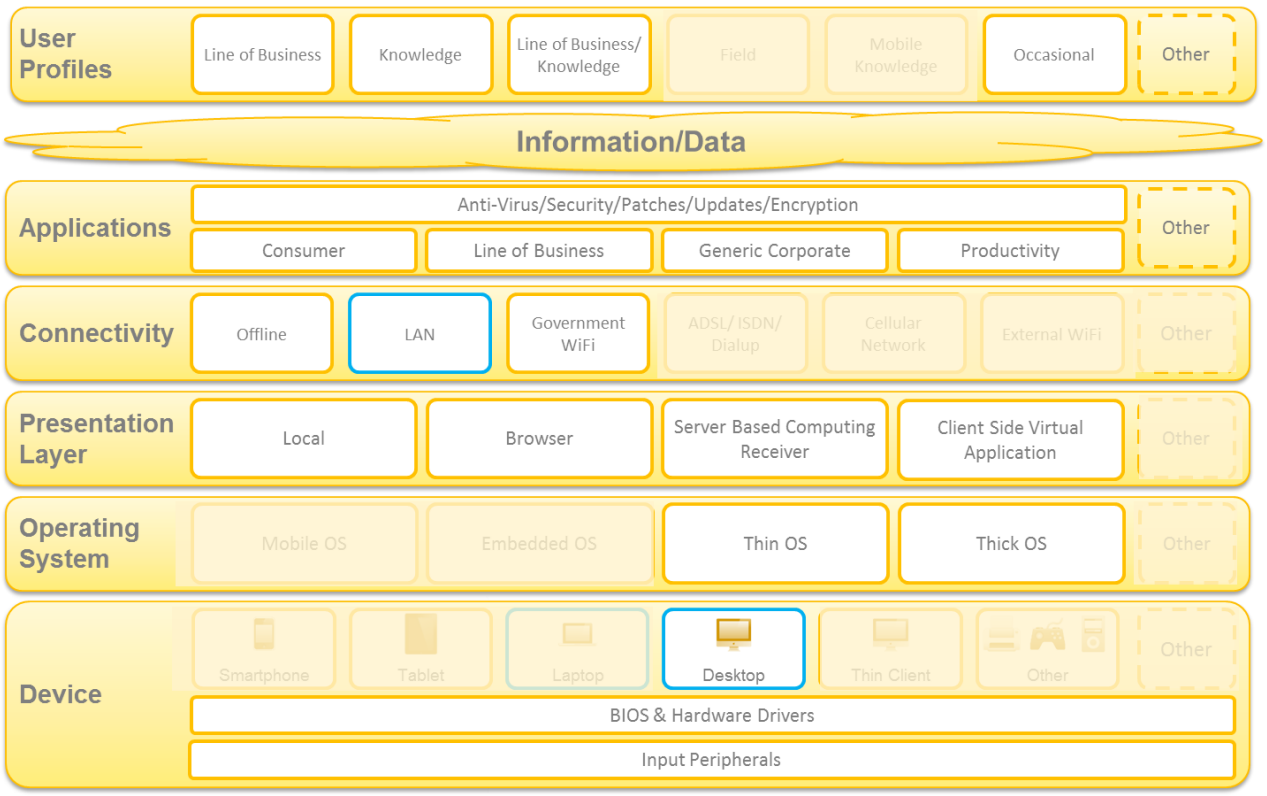

FIGURE 23 – EUD FRAMEWORK LIGHTBOARD FOR DESKTOP DEVICE

4.4.1.1 Desktop: Operating System Considerations

Figure 23 above depicts a desktop, and details the form of OS which can run on a desktop. Currently the following Operating Systems types are considered.

- Thin OS
- Thick OS

Currently the framework only considers these two desktop operating system types. The framework is extensible to accommodate other operating systems but these are considered to be the current market leaders and most relevant for consideration within the EUD framework.

4.4.1.2 Desktop: Presentation Layer Considerations

FIGURE 24 – EUD FRAMEWORK LIGHTBOARD FOR DESKTOP: PRESENTATION LAYER

Desktop devices are compatible with all of the presentation layer technologies for application delivery:

- Local - application is either part of the Operating System or installed onto the operating system and runs locally on the desktop.
- Browser - utilisation of the desktop Operations System's browser or other locally installed browser.
- Server Based Computing Receiver - running an application via an installed Server Based Computing Receiver.
- Client Side Virtual Application- running applications which are optimised to function on a virtual infrastructure and may be delivered through application streaming.

4.4.1.3 Desktop: Application Considerations

Desktops are compatible with Consumer, Line of Business, Generic Corporate and Productivity applications. As the Desktop device can meet a number of worker requirements, no specific application type is called out as recommended above others.

FIGURE 25 – EUD FRAMEWORK LIGHTBOARD FOR DESKTOP: APPLICATIONS

In the following sections, the four types of application presentation layer are compared:

- Local Application
- Browser Application
- Client Side Virtual Application
- Server-Based Computing Application

4.4.1.3.1 Desktop: Local Applications Applications Matrix

		Attributes
User Experience	Content Creation	**Very Good** due to native access to device capabilities and ability to store data locally.
	Content Management	**Very Good** due to native access to device capabilities and ability to store data locally.
	Content Consumption	**Very Good** due to native access to device capabilities and ability to store data locally.
Network Connectivity		**None required** unless data is held in an alternate location to the device.
Development Cost/Effort		**High** for bespoke applications. **Lower** for off the shelf/commercial applications.
Support Cost/Effort		**High** for local data, lower cost for centrally stored data although there are still multiple instances of the

		application delivered to each platform/device.

The table above highlights that a local application, running on a desktop offers a very good user experience for content creation, management and consumption. Local applications are developed for the platform on which they are running, and have access to the native devices capabilities. Native applications are compiled and offer better performance than applications that are interpreted at runtime. Another factor in the good user experience for local applications is that such applications can store data locally (on the device). Most types of web (browser) applications cannot store data locally.

4.4.1.3.2 DESKTOP: BROWSER APPLICATIONS MATRIX

		Attributes
User Experience	Content Creation	**Good** but limited due to lack of native device access.
	Content Management	**Good** but limited due to lack of native device access.
	Content Consumption	**Good** but limited due to lack of native device access.
Network Connectivity		**Persistent connection required** when application is being accessed.
Development Cost/Effort		**High** creation costs for bespoke applications. Potential infrastructure expenditure required to create a suitable hosting platform and network connectivity.
Support Cost/Effort		**Low** as application and data are stored centrally.

The table above shows that Browser (web) applications can offer a good user experience, but browser applications have some limitations compared to local applications which limit the user experience. In any consideration of browser applications capabilities it is worth highlighting that there are two key types:

- **Old Style Web Applications** – This refers to web applications developed before HTML5. Competition between browser makers meant that different browser manufacturers implemented browser standards differently, and early web applications were reliant on a number of browser plug-ins. This meant that a web application either required a specific browser/plug-in combination to work, or offered a different user experience on different browsers. Some applications developed within organisation only worked on a given browser version and many organisations are facing challenges with web application compatibility when moving to a newer browser version.
- **HTML5 Web Applications** – Most newly created web applications are developed to HTML5 standards, which can eliminate many of the issues created by older web applications. Well written HTML5 applications can offer a similar user experience on different vendor browsers, and the most recent browsers offer a very high level of HTML5 standards compliance. HTML5 applications still have limitations compared to local applications, however can offer a user experience closer to that of a local application. Some HTML applications are also starting to

offer some local data storage, however this is one area where support is limited to given browsers and platforms.

As such, local applications are considered to offer a very good user experience, whereas the limitation highlighted above mean that browser applications are considered to offer a good user experience in comparison.

4.4.1.3.3 Desktop: Server Based Computing Receiver Applications Matrix

		Attributes
User Experience	Content Creation	**Good** but can be limited by network constraints. No offline capability and some peripheral limitations.
	Content Management	**Good** but can be limited by network constraints. No offline capability and some peripheral limitations.
	Content Consumption	**Good** but can be limited by network constraints. No offline capability and some peripheral limitations.
Network Connectivity		**Persistent connection required** when application is being accessed.
Development Cost/Effort		**High** initial start-up costs and capital expenditure. Costs may be lower than both local and browser if the app is developed for use on multiple form factor devices.
Support Cost/Effort		**Low** as all data is maintained centrally. Support cost should be lower than managing separate instances of a business app for local install Thick OS, local install mobile OS, etc. No marginal cost for each new (receiver compatible) device.

In this model the desktop users a Server Based Computing Receiver. A remoting protocol is used to send data from a data centre hosted desktop or application to the remote device. When good network bandwidth and good local processing power is available on the local client, then the user will perceive a good or very good user experience, very similar to a locally installed application. However, if there are limitations on available network bandwidth or peaks in network usage then the user may experience suffer compared to a local application. In addition, there may be some issues with certain types of peripherals (as described in 4.3.3.3.2 Advantages and Disadvantages) not all peripherals may work. In summary, local applications are considered to offer a very good user experience, whereas the limitations highlighted above mean that Server Based Computing Receiver applications are considered to offer a good user experience in comparison.

4.4.1.3.4 Desktop: Client Side Virtual Application Applications Matrix

		Attributes
User Experience	Content Creation	**Very good** for compatible applications, however consideration does need to be made for application compatibility and application interoperability.
	Content Management	**Very good** for compatible applications, however consideration does need to be made for application compatibility and application interoperability.
	Content Consumption	**Very good** for compatible applications, however consideration does need to be made for application

		compatibility and application interoperability.
Network Connectivity		**None required** as applications may function offline.
Development Cost/Effort		**Medium** to allow for the initial infrastructure and licensing costs of virtualisation. This application type allows the easiest sharing of usage licences.
Support Cost/Effort		**Medium** as support and updates can be conducted remotely and streamed as necessary to device.

The final application type considered is a Client Side Virtual Application. If an application is compatible with application virtualisation technology, , then the experience can be exactly the same as a local application. However, it should be noted that not all applications can be virtualised as described in 4.3.3.4 Client Side Virtual Application. Additionally if virtual applications are to interoperate with other virtual (and locally installed) applications, then consideration for these interoperability mechanisms (e.g. cut, copy, paste, OLE linking, drag-and-drop, etc.) needs to be taken into account when the application is sequenced.

In terms of lowest cost and least change from the way traditional (thick) desktops work today, running a desktop application via application virtualization on a user's thick client device is considered to be the cheapest, easiest, and most reliable method for delivering a desktop application.

4.4.1.4 Desktop: Connectivity Considerations

Desktops are fixed in one location and have permanent network connectivity using the Local Area Network (LAN) yet are compatible with Government WiFi (if required) and support off-line working using local or cached applications in the event of network failure.

FIGURE 26 – EUD FRAMEWORK LIGHTBOARD FOR DESKTOP: CONNECTIVITY

4.4.1.5 Desktop: Security Considerations

If desktop PCs are configured in a secure managed, and well-managed, then they are relatively more secure that equivalently configured and managed laptops. Desktops are generally in a fixed location and connected to an internal network. If the desktops have been procured by the Government Procurement Service then they will be to an agreed set of standards. Such desktops are generally more secure than employee home desktops over which the IT department do not have full control of configuration, applications and local data.

4.4.1.6 Desktop: Identity Assurance Considerations

Identity Assurance issues may be raised by the choice of applications. These can be overcome in the following ways:

- Trusted Devices- Known devices can connect to secure applications and data sources in the knowledge that all information is protected.

- Federated Identity- Applications will utilize secure protocols and standard user names & passwords to authenticate to the data source

4.4.1.7 DESKTOP: SUPPORT & MANAGEMENT CONSIDERATIONS

Desktops devices generally have lower support costs than other devices due to their lower cost and the standardised nature of their hardware/operating systems. They are likely to remain located in a single office location throughout their usable life and are therefore less to be damaged or stolen than more portable devices. When considering the overall support cost for a desktop, the mode of application use needs to be considered. Due to high network connectivity, desktops are prime candidates for remote support and management for most preventative and repair activities. Desktops running a Thin OS will often store their data off their device in a network location resulting in more support issues being found in the data centre than with the device.

Desktops running local applications will require more local support for support and management compared to those running Server Based Computing applications or Client Side Virtual Applications.

4.4.2 DEVICE: LAPTOP

The EUD framework defines a Laptop as the following to inform the component options available: A laptop computer is a personal computer (PC) for mobile use. A laptop integrates most of the typical components of a desktop computer, including a display, a keyboard, a pointing device (a touchpad, also known as a track pad or pointing stick) and speakers into a single unit. A laptop is powered by mains electricity via an AC adapter, and can be used away from an outlet using a rechargeable battery.

The following lightboard shows the incompatible, compatible and recommended use cases for a laptop device.

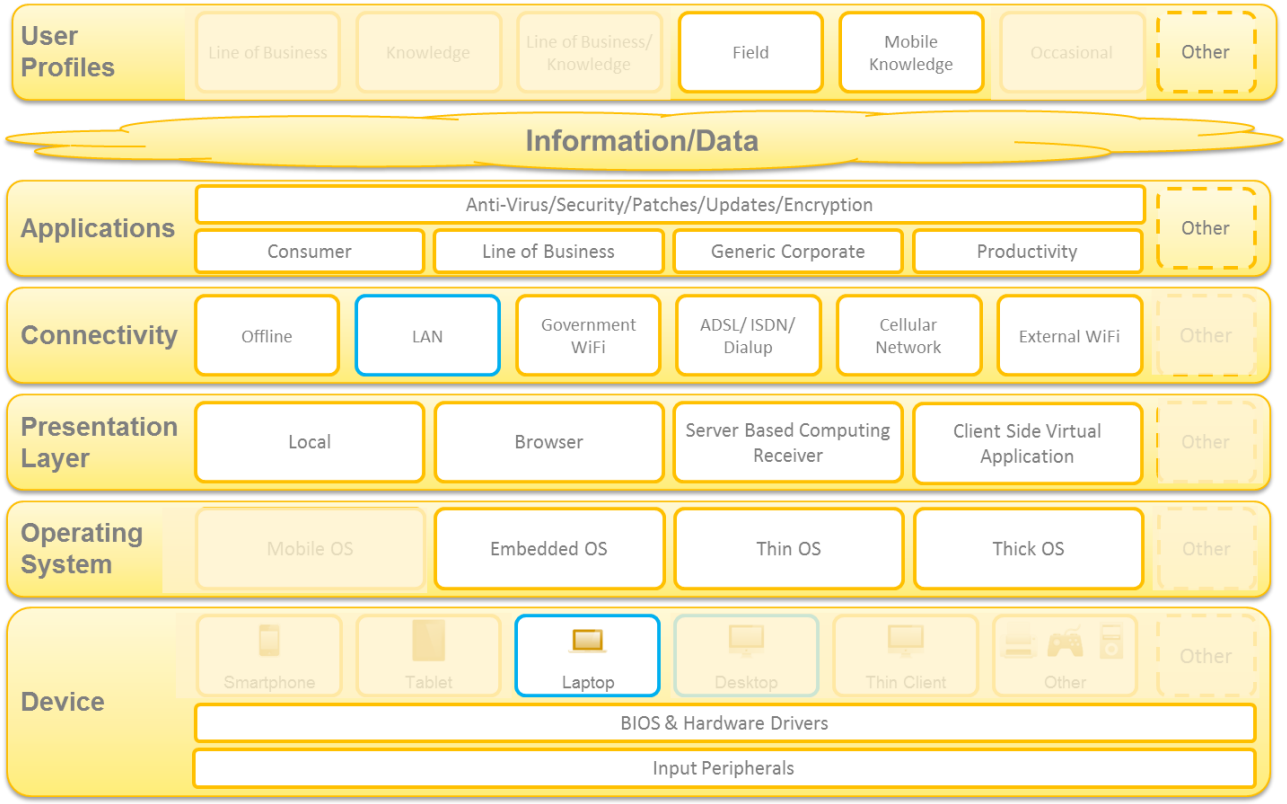

FIGURE 27 – EUD FRAMEWORK LIGHTBOARD FOR LAPTOP DEVICE

4.4.2.1 LAPTOP: OPERATING SYSTEM CONSIDERATIONS

Above, the framework depicts a laptop, and details the form of OS which can run on a laptop. Currently the following Operating Systems types are considered.

- Embedded OS[3]
- Thin OS
- Thick OS

[3] At the layer 2 framework level, examples of specific products are not generally provided. For clarity the embedded OS, Google Chrome running on compliant hardware (e.g. Samsung Series 5 Chromebooks) is provided here

Currently the framework only considers these three laptop operating system types. The framework is extensible to accommodate other operating systems but these are considered to be the current market leaders and most relevant for consideration in the EUD strategy.

4.4.2.2 LAPTOP: PRESENTATION LAYER CONSIDERATIONS

FIGURE 28 – EUD FRAMEWORK LIGHTBOARD FOR DESKTOP: PRESENTATION LAYER

Laptop devices are compatible with all of the presentation layer technologies for application delivery:

- Local - application is either part of the Operating System or installed onto the operating system and runs locally on the laptop.
- Browser – Operating System's browser or other locally installed browser
- Server Based Computing Receiver - running an application via an installed Server Based Computing Receiver.
- Client Side Virtual Application- running applications which are optimised to function on a virtual infrastructure and may be delivered through application streaming.

4.4.2.3 LAPTOP: APPLICATION CONSIDERATIONS

Laptops are compatible with Consumer, Line of Business, Generic Corporate and Productivity applications. As the laptop device can meet a number of worker requirements, no specific application type is called out as recommended above others.

FIGURE 29 – EUD FRAMEWORK LIGHTBOARD FOR LAPTOP: APPLICATIONS

The four types of application presentation layer for desktops are compared in section 4.4.1.3.1 Desktop: Local Applications Applications Matrix through to section 4.4.1.3.4 Desktop: Client Side Virtual Application Applications Matrix; the details for laptops are the same as those for desktops and as such are not repeated here.

4.4.2.4 LAPTOP: CONNECTIVITY CONSIDERATIONS

Laptops are not fixed in any location and have variable network connectivity. In a traditional office based environment, this may be using the Local Area Network (LAN) or Government WiFi (if available and required). In the event of network failure laptops can support off-line working using local or cached applications. In remote or mobile locations, laptops may be connected using external WiFi or 3G/GPRS data cards.

FIGURE 30 – EUD FRAMEWORK LIGHTBOARD FOR LAPTOP: CONNECTIVITY

4.4.2.5 LAPTOP: SECURITY CONSIDERATIONS

Laptop security must be able to operate in a local, single machine without connectivity to the main security infrastructure. This is important to ensure that user identification, authentication and authorization are not compromised while the system is not connected to the home network.

The protection of the device software is more critical than with desktops as the laptop's greatest strength – its portability is also its greatest weakness. A laptop is easily moved from a public location where attempts to gain access to the system can be performed at the discretion of the thief. Security must be strong and multi-tiered to prevent access. Security is also more critical for laptops than desktops because they may also contain data downloaded for offline working.

Lastly, one of the main benefits of having a personal laptop is for the convenience of having computing and networking resources easily accessed, wherever the user is located. In order for security to be universally and effortlessly adopted, security features must be simple to implement, use and manage. Security features must not significantly inconvenience the user and furthermore the user must not be able to disable security features.

4.4.2.6 LAPTOP: IDENTITY ASSURANCE CONSIDERATIONS

Identity Assurance issues may be raised by the choice of applications. These can be overcome in the following ways:

- Trusted Devices- Known devices can connect to secure applications and data sources in the knowledge that all information is protected.
- Federated Identity- Applications will utilize secure protocols and standard user names & passwords to authenticate to the data source

4.4.2.7 LAPTOP: SUPPORT & MANAGEMENT CONSIDERATIONS

Laptops have reasonable support costs compared to other devices due to their cost and the standardised nature of their hardware/operating systems within organisations. Laptops, however, are prone to loss or theft bringing concerns for loss of data. This data can be secured, recovered or wiped by using device management software (on the server or the device) as well as being built into the Identity Assurance. Due to the remote working requirements, laptops are potential candidates for remote support and management for most preventative and repair activities. Laptops running a Thin OS on a repurposed device will often store their data in a network location resulting in more support issues being found in the data centre than with the device.

4.4.3 Device: Thin Client

A thin client (sometimes also called a lean or slim client) is a computer which depends heavily on some other computer (its server) to fulfil its traditional computational roles. This stands in contrast to the traditional thick client, a computer designed to take on these roles by itself. The exact roles assumed by the server may vary, from providing data persistence (for example, for diskless nodes) to actual information processing on the client's behalf.

Important Note

There is a class of thin client, called an ultra-thin client or a zero client. Such clients do not have a full operating system: the kernel instead merely initializes the network, begins the networking protocol, and handles display of the server's output.

The following lightboard shows the incompatible, compatible and recommended use cases for a Thin Client device.

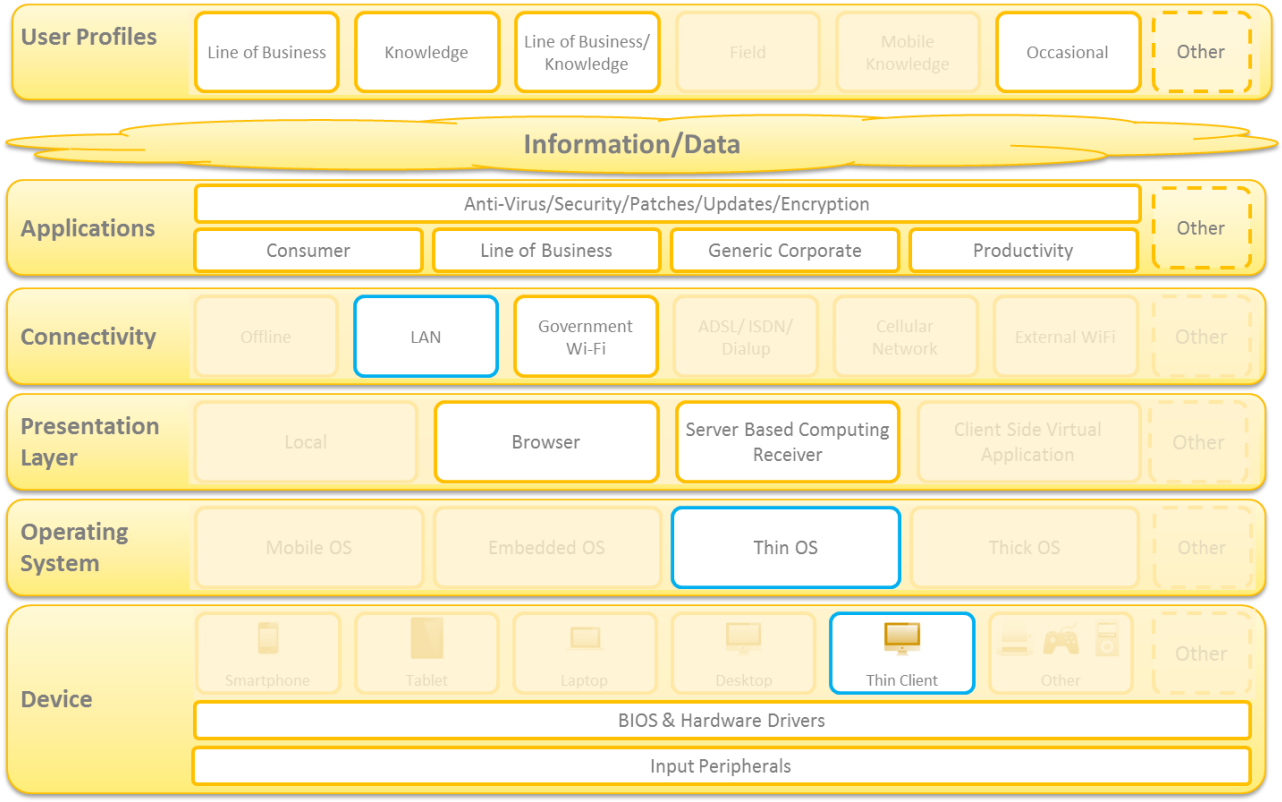

FIGURE 31 – EUD FRAMEWORK LIGHTBOARD FOR THIN CLIENT DEVICE

4.4.3.1 Thin Client: Operating System Considerations

As thin client devices rely on a server in order to perform the vast majority of the computational load, Thin Operating Systems have been developed to reduce the hardware requirements of the device. These are the only operating systems which should be utilised on Thin Client terminals.

4.4.3.2 THIN CLIENT: PRESENTATION LAYER CONSIDERATIONS

FIGURE 32– EUD FRAMEWORK LIGHTBOARD FOR THIN CLIENT: PRESENTATION LAYER

Thin client devices are compatible with two of the presentation layer technologies for application delivery:

- Browser - utilisation of the Operations System's browser or other locally installed browser.
- Server Based Computing Receiver - running an application via an installed Server Based Computing Receiver.

Local applications and Client-Side Virtual Applications cannot be run on thin client devices.

4.4.3.3 THIN CLIENT: APPLICATION CONSIDERATIONS

Thin Client devices are compatible with Consumer, Line of Business, Generic Corporate and Productivity applications. As the thin client device can meet a number of worker requirements, no specific application type is called out as recommended above others.

FIGURE 33 – EUD FRAMEWORK LIGHTBOARD FOR THIN CLIENT: APPLICATIONS

The two types of application presentation layer appropriate for thin client are Browser and Server-Based Computing Receiver and these are discussed in sections 4.4.1.3.2 Desktop: Browser Applications Matrix and 4.4.1.3.3 Desktop: Server Based Computing Receiver Applications Matrix and the considerations for thin client are the same as those for desktops and as such are not repeated here.

4.4.3.4 THIN CLIENT: CONNECTIVITY CONSIDERATIONS

Thin Clients are fixed in one location and have permanent network connectivity using the Local Area Network (LAN) yet are compatible with Internal WiFi (if required). Thin clients cannot provide access to applications when offline.

FIGURE 34 – EUD FRAMEWORK LIGHTBOARD FOR THIN CLIENT: CONNECTIVITY

4.4.3.5 THIN CLIENT: SECURITY CONSIDERATIONS

Thin clients are generally considered to offer greater security than end-user devices where applications and data exist on the local device. Desktops and application are made available to an end user devices using a remoting (thin client) protocol, with the desktop or application running on a server in the data centre with only input and output (e.g. keyboard input and screen refresh data) going over the network. This centralized processing generally makes it easier to manage and monitor

system access and to enforce security policies and procedures, so that internal security risk is reduced.

Due to the need for permanent network connection, thin client devices are generally located in offices and as such the devices themselves are less likely to be stolen or lost than devices which are portable.

4.4.3.6 Thin Client: Identity Assurance Considerations

Identity Assurance issues may be raised by the choice of applications. These can be overcome in the following ways:

- Trusted Devices- Known devices can connect to secure applications and data sources in the knowledge that all information is protected.
- Federated Identity- Applications will utilize secure protocols and standard user names & passwords to authenticate to the data source

4.4.3.7 Thin Client: Support & Management Considerations

Thin Client devices generally have lower support costs than other devices due to their lower cost and the standardised nature of their hardware/operating systems. In particular, they are easier to patch and upgrade than a traditional thick client device. When considering the overall support cost for a thin client, the mode of application use needs to be considered to understand a complete picture. Due to high network connectivity, thin clients are prime candidates for remote support and management for most preventative and repair activities..

4.4.4 Device: Smartphone

The EUD framework defines a Smartphone as “a mobile phone built on a mobile computing platform, with more advanced computing ability and connectivity than a feature phone”.

The following lightboard shows the incompatible, compatible and recommended use cases for a smartphone device.

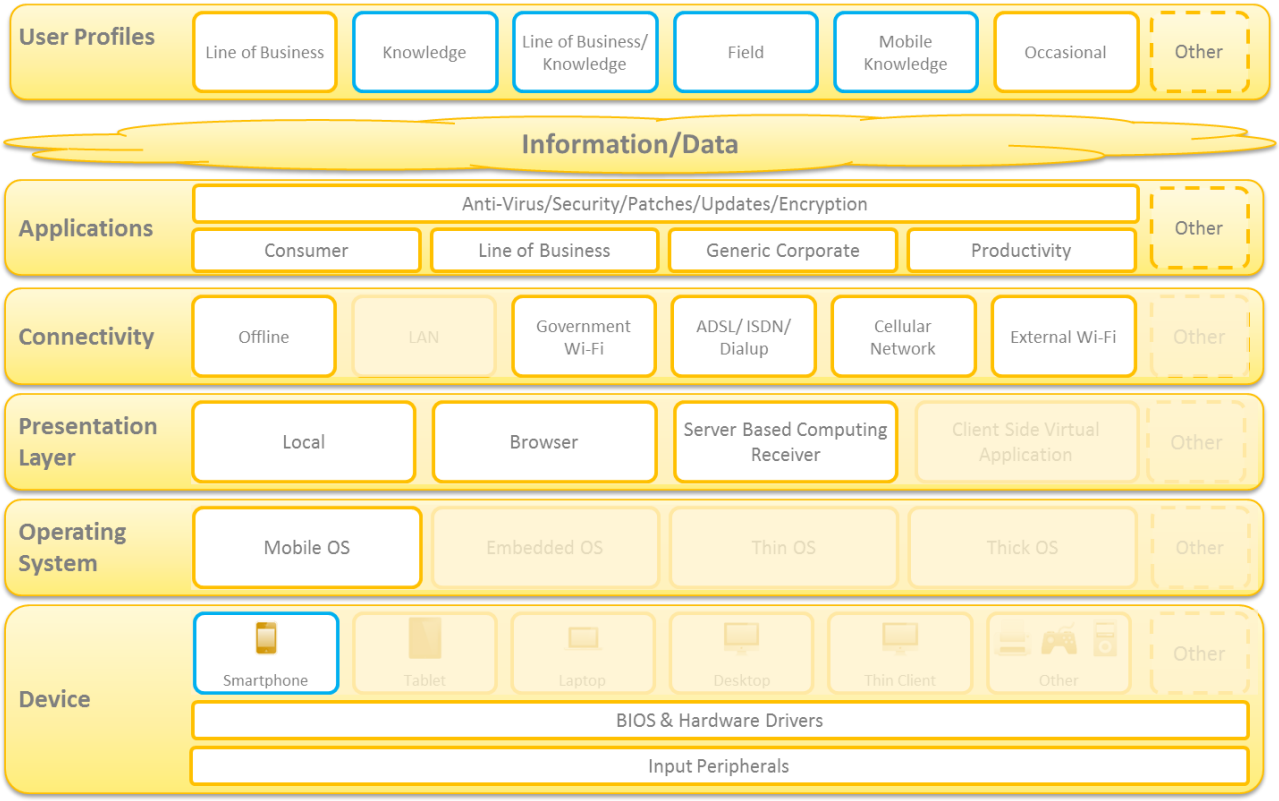

FIGURE 35 – EUD FRAMEWORK LIGHTBOARD FOR SMARTPHONE DEVICE

4.4.4.1 Smartphone: Operating System Considerations

In general one mobile OS can run on that hardware device. For example, Apple iPhones run the iOS operating system. The choice of operating system will therefore limit the choice of device or vice versa- they are strictly coupled.

Important Note

It has been technically possible on some Smartphones to run some mobile OS on smartphones not designed for that device (sometimes using a process called jail breaking) however this is not generally supported by mobile device vendors and not considered a recommended approach in Government and as such is not further discussed in this document.

4.4.4.2 Smartphone: Presentation Layer Considerations

FIGURE 36 – *EUD FRAMEWORK LIGHTBOARD FOR SMARTPHONE: PRESENTATION LAYER*

Smartphones can support the running of the following applications:

- Local (Native) - application included in the smartphone OS, installed via the smartphone's Application Store or side loaded through an alternate mechanism. These could include commercially available applications as well as enterprise applications via private enterprise Application Stores or internal mobile application deployment mechanisms.
- Browser - utilisation of the smartphone's browser or via a browser installed from the smartphone's Application Store
- Server Based Computing Receiver - running an application via an installed Server Based Computing Receiver. Note that support for Server Based Computing Receiver is dependent on the specific smartphone and OS.

Client Side Virtual Applications are currently not supported by smartphones.

4.4.4.3 SMARTPHONE: APPLICATION CONSIDERATIONS

Smartphones are compatible with Consumer, Line of Business, Generic Corporate and Productivity applications. As the Smartphone device can meet a number of worker requirements, no specific application type is called out as recommended above others.

FIGURE 37 – EUD FRAMEWORK LIGHTBOARD FOR SMARTPHONE: APPLICATIONS

However, the means by which the application is delivered can make a difference to the user experience of using an application on a Smartphone. Smartphone access to Line of Business applications is reliant on the suitable presentation layer and relevant security being in place for the device.

As a Smartphone has a smaller form-factor than desktop, laptop or thin client device, and also different support for peripherals. The tables below consider a smartphone when used with its native capabilities (i.e. smartphone screen, and keyboard) rather than using external peripherals (e.g. external Bluetooth keyboard and mouse) which some devices support.

4.4.4.3.1 SMARTPHONE: LOCAL APPLICATIONS MATRIX

		Attributes
User Experience	Content Creation	**Limited** due to lack of dedicated input peripherals. Additionally the small form factor and resulting screen size of Smartphone is not optimal for certain content creation.
	Content Management	**Limited** due to lack of dedicated input peripherals. This could be improved if mobile applications are designed to make utilisation of alternative input

		methods, for example gesture based inputs or voice input.
	Content Consumption	**Good** for displaying rich text, images and media.
Network Connectivity		**None required** unless data is held in an alternate location to the device.
Development Cost/Effort		**High** for bespoke applications. **Low** for off the shelf/commercial applications. Cross platform mobile enterprise Application platforms (MEAP) which enable "develop once deploy many" approach reduce development/support cost. These platforms also provide a middle ware to enable offline/online synchronisation.
Support Cost/Effort		**High** for local data, lower cost for centrally stored data although there are still multiple instances of the application delivered to each platform/device.

4.4.4.3.2 SMARTPHONE: BROWSER APPLICATIONS MATRIX

		Attributes
User Experience	Content Creation	**Limited** due to lack of dedicated input peripherals. Additionally the small form factor and resulting screen size of Smartphone is not optimal for certain content
	Content Management	**Limited** due to lack of dedicated input peripherals. This could be improved if browser applications are designed to make utilisation of alternative input methods, for example gesture based inputs or voice input, however support for such methods are less likely to supported in a browser application than a local application.
	Content Consumption	**Good** for displaying rich text, images and media. For a good experience the web site developer must detect the device and render content to the device form factor (e.g. mobile.bbc.co.uk)
Network Connectivity		**Persistent connection required** when the application is being accessed unless data is synchronised to the device.
Development Cost/Effort		**High** creation costs for bespoke applications. After an initial investment into a content manager/transcoder, content can be generated per client.
Support Cost/Effort		**Low** as application and data are stored centrally.

4.4.4.3.3 SMARTPHONE: SERVER BASED COMPUTING RECEIVER APPLICATIONS MATRIX

		Attributes
User Experience	Content Creation	**Limited** due to lack of dedicated input peripherals. Additionally the small form factor and resulting screen size of Smartphone is not optimal for certain content
	Content Management	**Limited** due to lack of dedicated input peripherals. This could be improved if Server Based Computing applications are designed to make utilisation of

		alternative input methods, for example gesture based inputs or voice input, however at the time of writing these is limited support for such methods in Server Based Computing receivers.
	Content Consumption	**Good** for displaying rich text, images and media.
Network Connectivity		**Persistent connection required** when the application is being access unless data is synchronised to the device.
Development Cost/Effort		**High** initial start-up costs and capital expenditure. Costs may be lower than both local and browser if the app is developed for use on multiple form factor devices.
Support Cost/Effort		**Low** as all data is maintained centrally. Support cost should be lower than managing separate instances of a business app for local install Windows, local install BES, etc. No marginal cost for each new (receiver compatible) device.

4.4.4.4 Smartphone: Connectivity Considerations

Smartphones are by their nature separate from any wired network connections. They are designed to work using local applications and data when no connectivity is available. Connection is available through built in hardware and accompanying drivers based upon common connectivity protocols- GPRS, 3G or WiFi.

FIGURE 38 – EUD FRAMEWORK LIGHTBOARD FOR SMARTPHONE: CONNECTIVITY

4.4.4.5 Smartphone: Security Considerations

Smartphones generally fall into one of three security classifications:

- Managed Encrypted Service- push information securely to a device and provide full device management options and encrypted storage
- Secure Mobile Data Synchronisation/Managed Device- devices which support device management, such as required passwords and remote wipes
- No device management

4.4.4.6 Smartphone: Identity Assurance Considerations

Identity Assurance issues may be raised by the choice of applications. These can be overcome in the following ways:

- Trusted Devices- Known devices can connect to secure applications and data sources in the knowledge that all information is protected.
- Federated Identity- Applications will utilize secure protocols and standard user names & passwords to authenticate to the data source

4.4.4.7 SMARTPHONE: SUPPORT & MANAGEMENT CONSIDERATIONS

Smartphones have higher support costs than other general phone devices due to more complex nature of their hardware/operating systems. Smartphones, however, are also prone to loss or theft bringing concerns for loss of data. This data can be secured, recovered or wiped by using device management software (on the server or the device) as well as being built into the Identity Assurance. Alternative approaches include using the smartphone as a front to data stored elsewhere, with no local information stored on the device, to remove the risk of data loss.

4.4.5 DEVICE: TABLET

The EUD framework defines a Tablet computer, or a tablet, "as a mobile computer, larger than a mobile phone or personal digital assistant, integrated into a flat touch screen and primarily operated by touching the screen- these devices may also come with a separate or detachable keyboard".

Tablets typically have greater computing power than smartphones and are more portable than laptops or desktops.

The following lightboard shows the incompatible, compatible and recommended use cases for a tablet device.

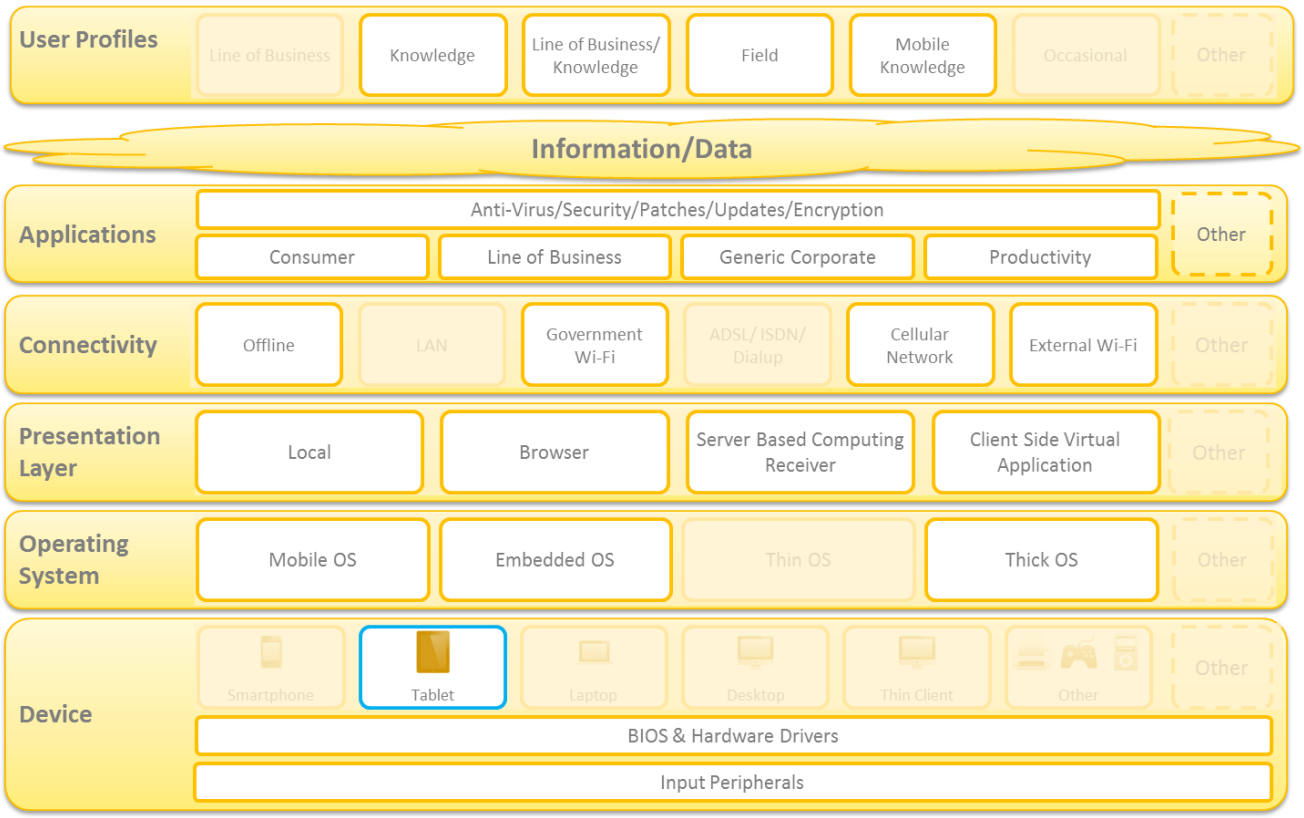

FIGURE 39 – EUD FRAMEWORK LIGHTBOARD FOR TABLET DEVICE

4.4.5.1 TABLET: OPERATING SYSTEM CONSIDERATIONS

Figure 39 above depicts a tablet, and details the form of OS which can run on a tablet. Currently the following Operating Systems types are considered, however the framework is extensible to accommodate other operating system types:

- Mobile OS
- Thick OS
- Embedded OS

In general table OS will be provided by the tablet vendor and pre-configured with appropriate drivers and software pertaining to the device hardware, however for tablets running Thick OS, this does allows for a customer government department specific build (i.e. OS configuration) to be developed for that device.

4.4.5.2 TABLET: PRESENTATION LAYER CONSIDERATIONS

Recent market developments have led to two different types of tablet devices existing- those running operating systems similar to those found on smartphones; and those which take the form of a traditional thick operating system. As these types of operating systems vary widely in their capabilities, the presentation layer considerations are different for each.

4.4.5.2.1 TABLET: PRESENTATION LAYER CONSIDERATIONS: MOBILE OS

FIGURE 40 – EUD FRAMEWORK LIGHTBOARD FOR TABLET: PRESENTATION LAYER: MOBILE OS

Tablets running mobile operating systems can support the running of the following applications:

- Local (Native) - application included in the Mobile OS, installed via the associated Application Store or side loaded through an alternate mechanism such as internal mobile application deployment mechanisms. These applications could include commercially available applications as well as enterprise applications via private enterprise Application Stores.
- Browser - utilisation of the Mobile OS browser or via a browser installed from the associated Application Store
- Server Based Computing Receiver - running an application via an installed Server Based Computing Receiver. Note that support for Server Based Computing Receiver is dependent on the specific smartphone and OS.

4.4.5.2.2 TABLET: PRESENTATION LAYER CONSIDERATIONS: THICK OS

FIGURE 41 – EUD FRAMEWORK LIGHTBOARD FOR TABLET: PRESENTATION LAYER: THICK OS

Tablet devices running traditional Thick OS are compatible with all of the presentation layer technologies for application delivery:

- Local - application is either part of the Operating System or installed onto the operating system and runs locally on the tablet.
- Browser – Operating System's browser or other locally installed browser
- Server Based Computing Receiver - running an application via an installed Server Based Computing Receiver.
- Client Side Virtual Application- running applications which are optimised to function on a virtual infrastructure and may be delivered through application streaming.

4.4.5.3 TABLET: APPLICATION CONSIDERATIONS

Tablets are compatible with Consumer, Line of Business, Generic Corporate and Productivity applications. As the tablet device can meet a number of worker requirements, no specific application type is called out as recommended above others.

FIGURE 42 – EUD FRAMEWORK LIGHTBOARD FOR TABLET: APPLICATIONS

However, the means by which the application is delivered can make a difference to the user experience of using an application on a Tablet. The tables below present an analysis based on the use of a tablet without externally attached peripherals such as keyboard and mouse. The use of such peripherals can of course make the user experience closer to that of a desktop or laptop.

4.4.5.3.1 TABLET: LOCAL APPLICATIONS MATRIX

		Attributes
User Experience	Content Creation	**Limited** compared to desktop/laptop due to lack of dedicated input peripherals but more effective than on a smartphone due to larger screen size.
	Content Management	**Limited** compared to desktop/laptop due to lack of dedicated input peripherals but more effective than on a smartphone due to larger screen size.
	Content Consumption	**Good** for displaying rich text, images and media.
Network Connectivity		**None required** unless data is held in an alternate location to the device.
Development Cost/Effort		**High** for bespoke applications. **Low** for off the shelf/commercial applications.
Support Cost/Effort		**High** for local data, lower cost for centrally stored data although there are still multiple instances of the application delivered to each platform/device.

4.4.5.3.2 TABLET: BROWSER APPLICATIONS MATRIX

		Attributes
User Experience	Content Creation	**Limited** compared to desktop/laptop due to lack of dedicated input peripherals but more effective than on a smartphone due to larger screen size.
	Content Management	**Limited** compared to desktop/laptop due to lack of dedicated input peripherals but more effective than on a smartphone due to larger screen size.
	Content Consumption	**Good** for displaying rich text, images and media. Limited due to lack of dedicated input peripherals. For a good experience the web site developer must detect the device and render content to the device form factor (e.g. mobile.bbc.co.uk)
Network		**Persistent connection required** when application is

Connectivity		being access unless data is synchronised to the device.
Development Cost/Effort		**High** creation costs for bespoke applications.
Support Cost/Effort		**Low** as application and data are stored centrally.

4.4.5.3.3 Tablet: Server Based Computing Receiver Applications Matrix

		Attributes
User Experience	Content Creation	**Limited** compared to desktop/laptop due to lack of dedicated input peripherals but more effective than on a smartphone due to larger screen size.
	Content Management	**Limited** compared to desktop/laptop due to lack of dedicated input peripherals but more effective than on a smartphone due to larger screen size.
	Content Consumption	**Good** for displaying rich text, images and media.
Network Connectivity		**Persistent connection required** when application is being access unless data is synchronised to the device.
Development Cost/Effort		**High** initial start-up costs and capital expenditure. Costs may be lower than both local and browser if the app is developed for use on multiple form factor devices.
Support Cost/Effort		**Low** as all data is maintained centrally. Support cost should be lower than managing separate instances of a business app for local install Thick OS, local install Mobile OS, etc. No marginal cost for each new (receiver compatible) device.

4.4.5.3.4 Tablet: Client Side Virtual Application Applications Matrix

Client Side Virtual Applications clients are generally only available on a tablet device running a Thick OS. In this situation the user experience is similar to that experienced when using a virtual application on a desktop or laptop as described in 4.4.1.3.4 Desktop: Client Side Virtual Application Applications Matrix.

4.4.5.4 Tablet: Connectivity Considerations

Tablets are by their nature separate from any wired network connections. They are designed to work using local applications and data when no connectivity is available. Connection is available through built in hardware and accompanying drivers based upon common connectivity protocols- GPRS, 3G or WiFi.

FIGURE 43 – EUD FRAMEWORK LIGHTBOARD FOR TABLET: CONNECTIVITY

4.4.5.5 Tablet: Security Considerations

Tablets generally fall into one of two security classifications:

- Secure Mobile Data Synchronisation/Managed Devices which support device management, such as required passwords and remote wipes
- No device management

4.4.5.6 TABLET: IDENTITY ASSURANCE CONSIDERATIONS

Identity Assurance issues may be raised by the choice of applications. These can be overcome in the following ways:

- Trusted Devices- Known devices can connect to secure applications and data sources in the knowledge that all information is protected.
- Federated Identity- Applications will utilize secure protocols and standard user names & passwords to authenticate to the data source

4.4.5.7 TABLET: SUPPORT & MANAGEMENT CONSIDERATIONS

Tablets may have lower support costs than other devices due to their lower initial purchase cost and the standardised nature of their hardware/operating systems. Tablets, however, are prone to loss or theft bringing concerns for loss of data. This data can be secured, recovered or wiped by using device management software (on the server or the device) as well as being built into the Identity Assurance. Alternative approaches include using the tablet as a front to data stored elsewhere, with no local information stored on the device, removing the risk of data loss.

5 FRAMEWORK LEVEL 3 – SOLUTION GUIDELINES

The framework level 3 will provide Solution Guidelines for suppliers and government departments to refer to at all phases of a transformation programme. The framework level 3 analyses each level 2 component, providing examples of product choices for this component and good practice guidelines with examples from other government organisations. For each component reference to industry analysis is provided which details the analyst's view of the products maturity, strengths and weaknesses.

This level of the framework will be presented in future EUD Programme document releases.

6 FRAMEWORK LEVEL 4 – SPECIFIC IMPLEMENTATION GUIDELINES

The framework level 4 can be used to describe a specific technology implementation, detailing the technology used with choices made for each component and all co-dependent links identified.

This level of the framework will be presented in future EUD Programme document releases.

7 JOURNEY PLANNING

The Journey Planning section will be developed through later releases of the Solution Framework but will provide guidance to organisations on how to apply the End User Device Framework to their organisation.

The key activities involved in an End User Device transformation are detailed below.

- Understand your current environment (the "as-is")
    - Applications
    - Users
    - End-User Devices
    - Desktop and Application Platforms
- Create user segments specific to your Organisation
- Identify Rationalisation Opportunities
- Create a target architecture
    - Rationalised Application Portfolio
    - Desktop and Application Delivery Platforms
    - End-User Devices
- Programme Implementation
    - Application Preparation
    - Platform Implementation
    - Deployment Planning and Execution
    - Service Introduction

The Journey Planning guidance will be presented in future EUD Programme document releases.

8 BRING YOUR OWN DEVICE (BYOD) CONSIDERATIONS

Bring Your Own Device (BYOD) Considerations will discuss BYOD and Consumerisation of IT, and their applicability to Government IT programmes. The section will present considerations and guidelines relating to the EUD Framework and standards as well as providing discussion topics to be held as part of the organisation's transformation strategy.

The BYOD Considerations guidance will be presented in future EUD Programme document releases.

This section will be developed and released as part of a future version of this document.

9 REFERENCES

The following documents are referenced in this document:

Reference	Document	Date/Version
[1]	End User Device Strategy (Word Document)	March 2011
[2]	End User Device Framework Overview (PowerPoint Presentation)	Friday 10th February
[3]	EUD Programme Vision Statement (Word Document)	November 2011
[4]	EUD Component Definition and RACI (Excel Spread sheet)	February 2012

10 GLOSSARY

Reference	Meaning
HTML	HyperText Markup Language
HVD	Hosted Virtual Desktop
IL	Impact Level, a.k.a. Business Impact Level is a standardised means of assessing the business impact of loss of confidentiality, integrity or availability of business assets owned, ranging from 0 (lowest) to 6 (highest).
OLE	Object Linking and Embedding
SBC	Server-Based Computing