California
DEPARTMENT OF TECHNOLOGY

California Enterprise Architecture Framework

eGovernment (eGov) Reference Architecture (RA)

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1 Introduction

With the growing adoption of the Internet, it has become feasible to support the interactions over the Net between the public and the government at any level (federal, state, or local). Since the late '90s, the concept has been put to practical use in many places - in the US and around the world. The resulting solutions have been referred to as "eGovernment", "eGov", or similar labels. The existing solutions offer a wealth of experiences; they involve a number of architectural and technological choices.

There are a number of lessons for Enterprise Architecture to be learnt from the past eGov initiatives. First, there is no single "one-size-fits-all" eGov solution. Rather, there are a small number of business scenarios for eGov, and any eGov solution should be considered in the context of those scenarios first. Second, successful eGov implementations are not built from scratch, but rather by integrating existing systems and applications, and by making them interoperable with new components, such as web portals. Third, although there are no eGov-exclusive building blocks or technology, there are a number of requirements and constraints that have to be addressed in order to build successful eGov solution. Adopting SOA as the architectural foundation makes it easier to create and evolve eGov solutions.

This Reference Architecture (further abbreviated as "RA") is a part of CEAF 2.0; it is not an isolated or stand-alone reference architecture, but rather it uses (and references) other RAs in CEAF 2.0, most notably SOA, EAI, and ECM RAs.

1.1 Purpose

The eGov Reference Architecture document provides guidelines and options for making architectural decisions when implementing eGov solutions.

The objectives for the document include the following:

- To distinguish the types of approaches to eGov based on differences in targeted capabilities.
- To provide guidance for creating or evaluating architectures for eGov solutions for discussed groups of capabilities.
- To identify building blocks (architectural layers, services, components) for integration in an eGov solution.
- To communicate the key architectural decisions relevant for creating or evaluating eGov solutions
- To communicate opportunities for solution and/or platform sharing at agency, cross-agency and/or state levels

1.2 Limitations

The subject of eGovernment is large, but this document is limited to a specific (and explicit) understanding of what eGov is and which of its areas can be a valid topic in a Reference Architecture. The section "eGov Overview" provides the details.

1.3 Intended Users

The primary intended users of this document are Enterprise Architecture practitioners and other architects that contribute to enterprise architecture. This broad group includes architects from other domains/disciplines such as Security, Application, Information, Business, Technology, Infrastructure, and Solution Architects. It also includes Managers, at senior or operational levels, who are involved with eGov or related areas, such as Service-Oriented Architecture, Enterprise Application Integration, Identity and Access Management, Enterprise Content Management, Cloud Computing, and similar areas.

1.4 Document Organization

The eGov Reference Architecture documentation is organized as follows:

- Section “Overview of eGov” provides background for the eGov RA by introducing descriptions and definitions of eGov, discusses the main usage scenario types found in eGov implementations, and identifies architectural components for respective usage scenarios
- The section “eGov Reference Architecture Description” provides a focused description of eGov Reference Architecture (RA) using Logical Views which provide an overview of relationships and interactions between components in an eGov solution for three main eGov scenarios.
- The section “Glossary” provides description of the terms and abbreviations used in the document.
- The section “References” lists publications used for preparation of the document.

1.5 Future Directions

Future evolution of the document includes the following steps:

- Adding an example or examples of existing realization of the eGov RA.
- Identifying and elaborating solution sharing opportunities.
- Formulating implementation guidelines for eGov RA.

2 Overview of eGov

This section introduces eGov by discussing some of its definitions and related challenges. The section also introduces main usage scenarios for eGov and the capabilities required for an eGov solution.

2.1 Definitions of eGov

There is no single accepted concept or definition of eGov. There are several definitions in circulation which differ as to the meaning or scope of the term "eGov". The definitions provided below illustrate different scope or stress in the understanding of what eGov is:

(A) *eGov is the employment of the Internet and the world-wide-web for delivering government information and services to the citizens*. (United Nations)

(B) *eGov is the use of the Web and other information technologies by governments to interact with the citizenry, between departments and divisions, and with other governments.* (World Wide Web Consortium, W3C)

(C) *eGov focuses on the use of new information and communication technologies (ICTs) by governments as applied to the full range of government functions. In particular, the networking potential offered by the Internet and related technologies has the potential to transform the structures and operation of government.* (Organisation for Economic Co-operation and Development , OECD)

The above characterizations differ in a number of respects:

- In the *scope of interactions*: is eGov limited to interactions between a government and citizens only or it is not? This document takes the approach that eGov is not so limited and can involve interactions with other groups of users, including interactions with business users, government employees, and other government agencies or even other governments.
- In the *type of technology involved*: does eGov involve any information and communication technologies (ICTs) or is rather limited to using the Internet? In this document, eGov using the Internet (rather than e.g. mobile telephony) is the primary focus and concern; other ICTs may be included in the future.
- In *stated goals and objectives*: does eGov include the goal of transforming the structures and operations of government, or its goals are rather limited to providing better or new forms of service delivery by governments to service consumers? Given that Reference Architectures deal with architecture and technology, the latter group is the adopted scope in this document.

There are a number of perspectives on eGov (as summarized in [7]), of which only two are applicable to a Reference Architecture document. The following figure provides an overview:

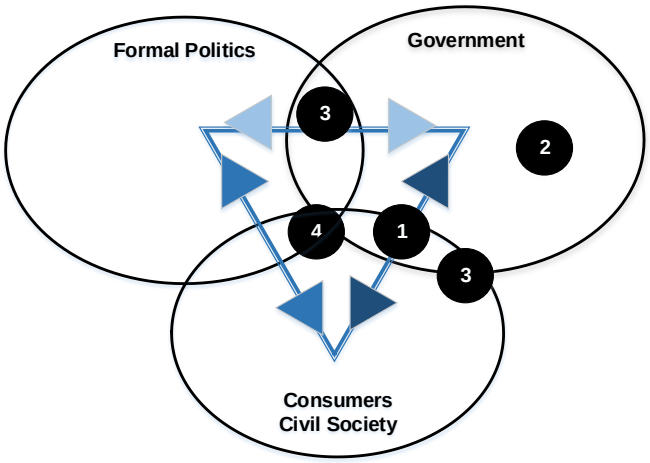

Figure 2-1 Four Perspectives on eGov

In the above figure, the meaning of the numbered lines is as follows:

1. On-line service delivery and interaction with Consumers
2. Use of IT within Government with focus on the delivery of services and processing
3. Capacity to transform public administration through the use of IT
4. Tool to achieve a "better government"

Note that only perspectives (1) and (2) are relevant to reference architecture subject matter and are considered in this document. The problematic pertaining to transformation of public administration through the use of IT, and how eGov can lead to establishing a better government, are outside the scope of Enterprise Architecture – even if (1) and (2) may contribute to (3) and (4).

2.2 Uniqueness of eGov

It is commonly recognized that implementations of eGov involve complex system engineering, but this can also be said of many other types of initiatives, such as Business Intelligence or Identity and Access Management solutions. Moreover, there is no building block or technology that is specific to eGov.

Is eGov then in any way special or unique, rather than more or less standard (even if complex) information system? What arguably makes eGov unique is the combination of the following factors:

- The type and size of the audiences that eGov is expected to service; e.g., at the state level, all adult individuals are potential consumers for eGov.
- The type of constraints (market, legal, regulatory, etc.) that affect the interaction between eGov implementation and its users
- The time scale involved in eGov solutions, both in terms of how long it takes to incrementally implement a vision (e.g., expressed in a Target Enterprise Architecture) and how long the outcome is expected to be valid and useful to the users – in both cases, the period of time is years and decades rather than quarters and single years.
- In contrast to commercial services, eGov services do not operate in a competitive setting. The fundamental challenge for eGov services is not many similar offerings competing one

with another, but rather usable integration of existing and future services pertaining to different levels of government.

All above factors together affect the characteristics of the services in eGov. The following features are typically pointed out as conditions of success for eGov services:

- *Simplicity*, which means masking complexity that is irrelevant from the service's consumer perspective (such as internal organization of government, rather than just number of clicks on the website to a get to a desired function).
- *Friendliness*, which means high level of tolerance in face of consumers' mistakes, suspensions, resumes, and aborts of processing; this also includes high tolerance to varying levels of skill when it comes to using computers, and accommodating impairments.
- *Reliability*, which means that the interaction with government using eGov services will not be lost and that it will bring up expected outcomes.

Please note that the above features reflect users' perspective on eGov. Consequently, simplicity, friendliness, and reliability as characteristics of eGov solutions are success factors in terms of the scale of eGov adoption by the users. In turn, the scale of adoption affects the economic impact and ROI of eGov initiatives.

2.3 Business Benefits

From the business perspective, eGov is a way of introducing new channels of interaction between government and consumers of its services, in order to make this interaction more convenient to the consumers (in terms of ease of access and availability) and cheaper for the provider of the services. Successful adoption of eGov results in a number of business benefits, including the following:

- Facilitating access to government data and processes to all types of consumers of these services, be it general public, business, government agencies or their employees, or other governments. This facilitation has a number of aspects:
  - Access to eGov services can be provided on a continuous basis (rather than during business hours).
  - The access is typically cheaper than traditional forms of interaction (e.g., requiring physical access in person) for the consumers of services.
  - The access can be made simple by masking potentially complex procedures or organizational complexities.
- Improving operational characteristics of government, including the following:
  - Decreasing the cost to government of providing quality services to their consumers.
  - Decreasing the load on the office workers by making at least some types of data or some of business processes directly available to service consumers.
  - The reach of eGov services can be widened from initialized specialized groups to all consumers that have a need and a right for using the service without incurring substantial additional costs.

In addition to the adoption of eGov as such, adopting eGov within an explicit Enterprise Architecture framework (including the Target EA and EA Roadmap) has a number of distinct business benefits:

- It improves alignment of information technology with the state's missions, goals, and objectives.
- It improves statewide service delivery and business operations.
- It improves security, reliability and performance of the state's information technology infrastructure.
- It improves statewide data sharing and systems interoperability.
- It allows for more effective use of state resources thereby enabling consistent, effective delivery of services to the employees, citizens, and businesses of California.
- It improves enterprise-wide integration resulting in fewer occurrences of duplicate infrastructure, information silos, and application redundancy.

2.4 Main eGov Usage Scenarios

There are a number of usage scenarios types for eGov depending on the characteristics of the type of interaction between Service Consumer and services provided by eGov. Each scenario has different ramifications as to the capabilities that need supporting in the target architecture and as to the components and building blocks that will have to be used eventually for the solution. The main eGov usage scenarios are as follows:

- *Publish* usage scenarios, which represent publishing document or data in a way that allows for electronic accessing over internet, typically using a web site or a web portal.
- *Interact* usage scenarios, which allow consumers of the services to interact with government, but not in a way that involves transactional processing; for example, ability to exchange emails or to fill out feedback forms fall into this category.
- *Transact* usage scenarios, which represent interactions containing transactional component, such as on-line data entry or purchases.
- *Integrate* usage scenarios, which involve integration of services made available by eGov with other services or data (typically, from other sources) to produce new services. These scenarios involve publishing of eGov services (typically, as Web Services) and mashups of services with other services or data sources.

The above sequence of usage scenarios reflects the historical expansion of functional scope of eGov implementations: early implementations of eGov (starting in the mid-nineties) began with limited publish scenarios before adopting interactive and transactional scenarios. Similarly, many of the new eGov implementations tend to repeat the evolution path of starting with publish scenarios before providing support for interact or transact scenarios. The integrate scenarios, even though they form the core of so called eGov 2.0, are not yet as widely implemented as the other scenarios.

From the EA perspective, the practical relevance of eGov usage scenarios is that they provide a way of structuring eGov-related plans and architectures. When considering implementation of eGov, one of the first questions is what are the business needs that the particular eGov implementation is expected to address – while keeping in mind that the concrete eGov implementation may need to address a mix of the basic usage scenarios. Considering these needs from the perspective of eGov usage scenarios facilitates the answer.

The following table provides a summary of similarities and differences of the discussed usage scenario types:

Table 2-1 Similarities and Differences among main eGov Usage Scenario types

Facet/Usage Scenario	**Publish**	**Interact**	**Transact**	**Integrate**
Makes documents or data digitally available?	Yes	Yes	Yes	Yes
Supports non-transactional interactions?	No	Yes	Yes	Yes
Supports transactional interactions?	No	No	Yes	Yes
Exposes Service and/or data APIs for technical integration?	No	No	No	Yes

The above table provides first approximation of the type of capabilities (and consequently, of components/building blocks) that will be needed to satisfy basic requirements for each usage scenario.

In the described usage scenarios, there are a number of groups of service consumers, namely:

- The public – citizens, constituents, "civil society"
- Businesses (FPOs, NPOs)
- Government agency employees (incl. contractors and vendors)
- Other government agencies
- Other governments

Note that each of the above groups can be represented by non-human agents (software – applications or systems). Also, note that the described usage scenarios are not consumer-specific – that is, each of the usage scenarios in question could be *in principle* applied to any of the consumer types as listed above, even though some of the usage scenario-consumer type combinations are not likely to happen in practice (for example, transactional interactions between two governments of different countries are not likely to take place using respective eGov facilities).

The listed eGov usage scenarios are described in the subsections that follow.

2.5 Critical Capabilities of eGov Solutions

Capabilities that must be supported in a given eGov solution depend on the type of usage scenario that the solution is expected to support. The following table provides a summary of key capabilities for each of the discussed usage scenario types.

Table 2-2 Key and Supporting Capabilities of eGov Solution by Usage Scenario Type

Scenario	Key Capabilities	Supporting Capabilities
Publish	• Information (documents, "content") is available and easily accessible • The protocol of accessing the information is standardized (usually, http and its variants) • Searching documents (metadata and/or contents) is supported	• Means to digitize paper documents (and potentially other physical media) • Ability to publish the information in one of standard digital formats (e.g., pdf, html, xml) • Means to manage the digitized content • Making the content repository searchable using e.g. indexing of metadata and/or document content
Interact	• Support for execution of Business Processes (even if still partially manual) involving non-transactional interactions	• Support for asynchronous communication using email, web forms, and similar. • Support for synchronous communication using on-line chat and similar
Transact	• Support for on-line transactional processing	• Ability to process data transactionally (as a single unit of work) • Ability to persist data elements relevant to the transaction • Ability to accept payments in various forms from Consumers • Internal integration of systems/ applications as required by the scope of transactional processing available (partial vertical integration)
Integrate	• Support the "life event" paradigm • Publishing reusable/composable services (Web Services) • Provide for horizontal/vertical integration of systems involved in eGov Services	• Integration of systems/applications that can span multiple organizational units (vertical and horizontal integration) • Publishing data using standard APIs • Providing services using applicable standard protocols • Providing to API consumers ways to test interaction with the provided services without affecting Production.

2.5.1 Publish Usage Scenario

Publishing usage scenario in eGov is *functionally* the simplest and historically the earliest form of eGov. The scenario involves operations on a collection of digital artifacts (most often, documents) such as searching, viewing and/or downloading of the artifacts. The prerequisite for making those functions available are digital content creation and maintenance procedures and processes.

This type of usage scenarios can be characterized by the following:

- Government is the only *active* party in the interaction with service consumers.
- The role of the government is limited to making specific artifacts (typically, digitized artifacts) available for electronic access.
- The on-line services provided typically include search functions (ranging from basic to elaborate, depending on the implementation) that are performed on artifact's metadata and, if the artifact's type allows for it, also on its contents.

Most common approach to implementing the scenario is to adopt a portal-based solution to provide a single point of access to specific information or services. In public sector, there are a number of distinct types of portals, depending on the intended scope and type of services provided, such as the following:

- *Agency portals* are designed around specific administrative unit in public sector and provide access to that unit; for example, http://www.cio.ca.gov/ provides information about CA Department of Technology.
- *Government portals* provide access to a given government entity as a whole (rather than its part of unit), at the municipal (e.g., http://www.cityofsacramento.org/), county (e.g., http://www.co.merced.ca.us/) , state (e.g., http://www.texas.gov), national (e.g., http://www.ch.ch/ in Switzerland) or supranational government (e.g., http://europa.eu for European Union).
- *Audience portals* target specific audience and provide information and services relevant to that audience; for example, http://studentaid.ed.gov/ targets higher education students.
- *Cross-Agency portals* are operated jointly by several agencies and they bundle services from those agencies; for example, http://www.fedstats.gov/ or http://www.benefits.gov/.
- *Employee portals* are internal portals accessible to employees of an organization and typically managed by the IT department of that organization; for example, http://www.employeeexpress.gov/.
- *Topic portals* are organized around specific topic or area of interest to potentially many groups or audiences; for example, http://www.govsales.gov for government auctions, or http://www.govloans.gov/ for government loans.
- *Integration portals* provide single point of access to multiple related portals, often with search capabilities to help locate the candidate portals; for example https://usa.gov.

Publishing usage scenarios do not involve any capability to support or process any electronic feedback from the Consumers, so typically no transactional interactions are supported as the integral part of the solution.

The following figure shows how the key Business Function for the scenario – "Publish Digital Content On-Line" is supported by two Business Processes: one related to creating and

maintaining the content repository, and the other supporting actual on-line access for eGov users.

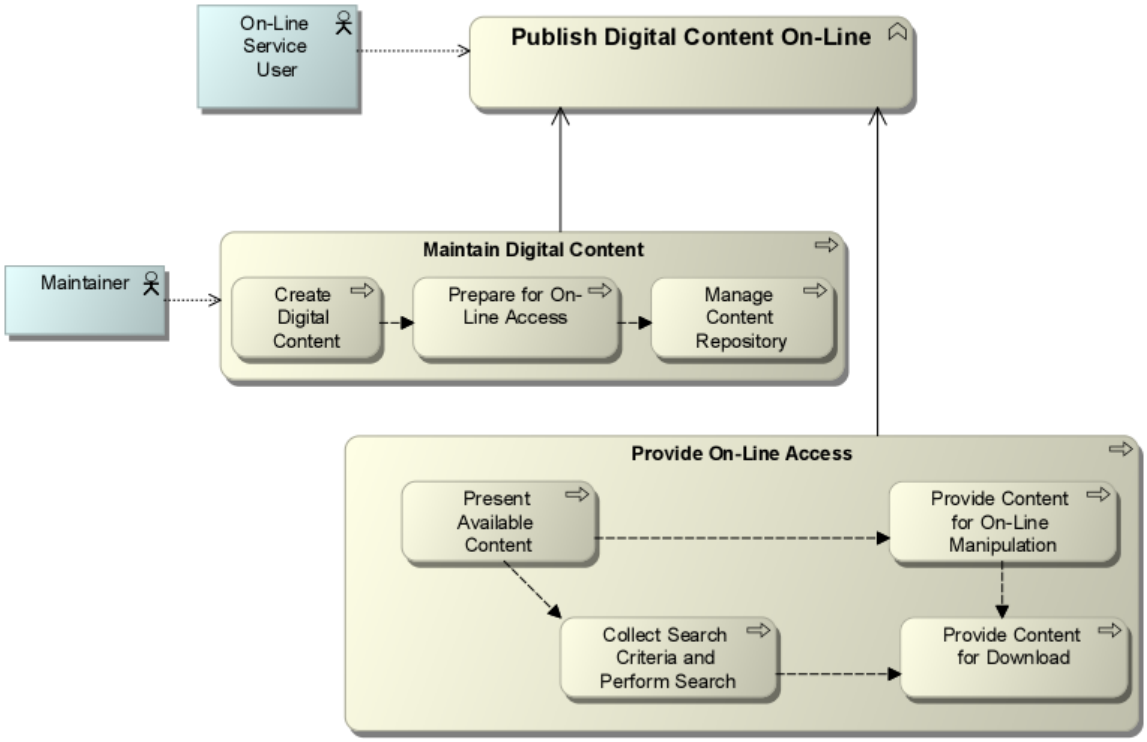

Figure 2-2 Business Function and Processes in the Publish Scenario

2.5.2 Interact Usage Scenarios

Interactive usage scenarios provide one or more ways for service Consumers to interact with the Service Provider. In its simplest form, the interaction can be based on ability to process emails from Consumers, or on ability to collect input from forms in the web pages made available in the Provider's website.

This type of usage scenarios can be characterized by the following:

- Government is the main but not the only active party in the interaction with service Consumers.
- Consumers are provided with means to originate digital interactions with government.
- The information provided by the service Consumers may serve as input to relevant Business Process on the Service Supplier side.

The following figure portrays the key Business Function for the Scenario (namely, supporting electronic interactions with eGov users) and Business Processes used to support the function:

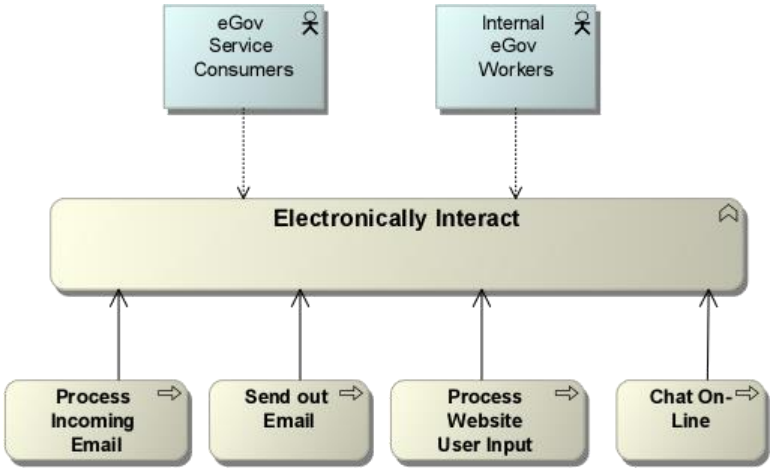

Figure 2-3 Business Function and Processes in the Interact Scenario

The following are examples of Interact usage scenarios:

- For asynchronous interactions:
  - Using emails for Q&A, providing feedback
  - Using simple web page forms to collect Consumer input
  - Using specialized products - such as editable wikis or forums - to collect Consumer input
  - Using fillable on-line forms, polls or questionnaires
- For synchronous interactions - using on-line chat facilities, which currently use textual exchanges, but which may use audio and video communication in the future.

2.5.3 Transact Usage Scenarios

Transactional usage scenarios involve interactions between Consumers and Service Provider involve transactional processing (units of work that either succeed or fail as a whole), which typically requires using a business application by the Provider.

Transact usage scenarios can be characterized by the following:

- Supporting transactional on-line processing
- Integrating the transactional functionality available on-line with at least some of the Business Processes on the government side
- In mature services, a single transaction from the Consumer's point of view may encapsulate multiple transactions, potentially spanning multiple organizational units, on the Service Provider side.

The following are examples of Transact Usage Scenarios:

- On-line application processing, e.g., registration of a business/company registration, or vehicle registration renewal, as illustrated in the following figure:

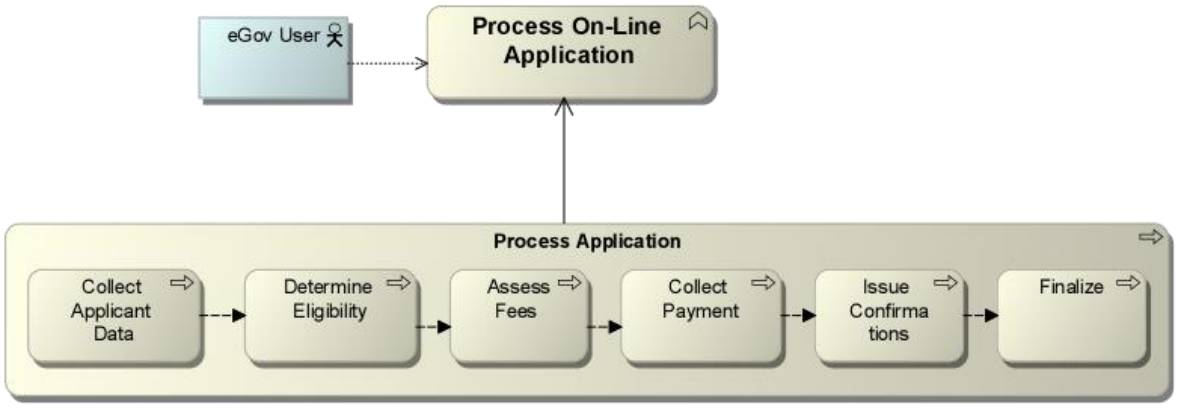

Figure 2-4 Business Function and Processes in On-Line Application Processing

- Relation management-type of interaction (which typically does not directly require monetary transactions), such as determination of services of interest to a given eGov user. This is shown in the following figure:

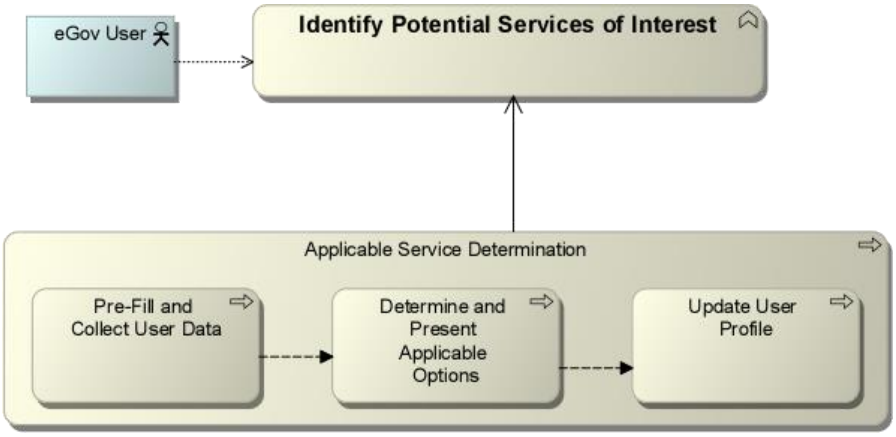

Figure 2-5 Business Function and Processes in a Relation Management Scenario

- *Event-based portals* bundle information and services relevant to events in enterprise (Business Event portals, e.g. http://www.basis.ie) or to an individual (e.g., http://employee.idaho.gov/lifeevents.htm).

2.5.4 Integrate Usage Scenarios

Integrative usage scenarios involve publishing of eGov services as services in a standard format, e.g. as Web Services, or publishing data sets or feeds in a prescribed format using a standard protocol of access (for example, XML as the format and http as the protocol). These usage scenarios differ from the previous types in that consuming of the services provided is not always possible using standard tools like web browser. Although consuming some types of services (like RSS feeds) can be done using standard web browsers (possibly with proper plugins built-in), the offered service presumes technical or developer knowledge which cannot be expected from the typical Consumer of eGov services.

Examples of integrative usage scenarios include the following:

- Publish a Web Service – either a simple Web Service or a composite Web Service (or a "mashup", which integrates existing internal and/or external web services, data sources, aggregators, etc.)
- Access an already published Web Service (this is also relevant for mashups).

The following figure shows a simplified Business Process to support a Business Function of making a web service available to service consumers:

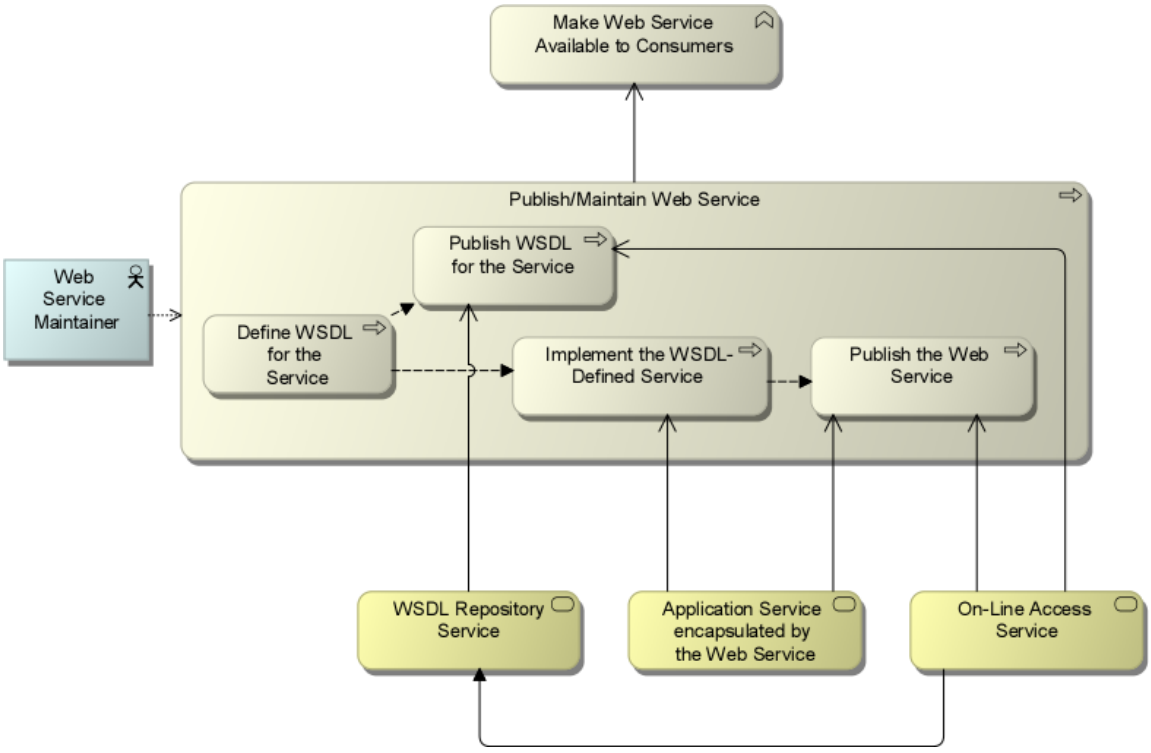

Figure 2-6 Publishing Web Service Scenario

The Business Process shown in the above figure outlines creation and maintenance of Web Service elements – its contractual definition in the form of WSDL, and its realization. This Process is executed by Web Service Creators and Maintainers.

The above scenario is distinct from accessing a published web services. In the following figure, another Business Process is shown that is executed by Web Service Consumers:

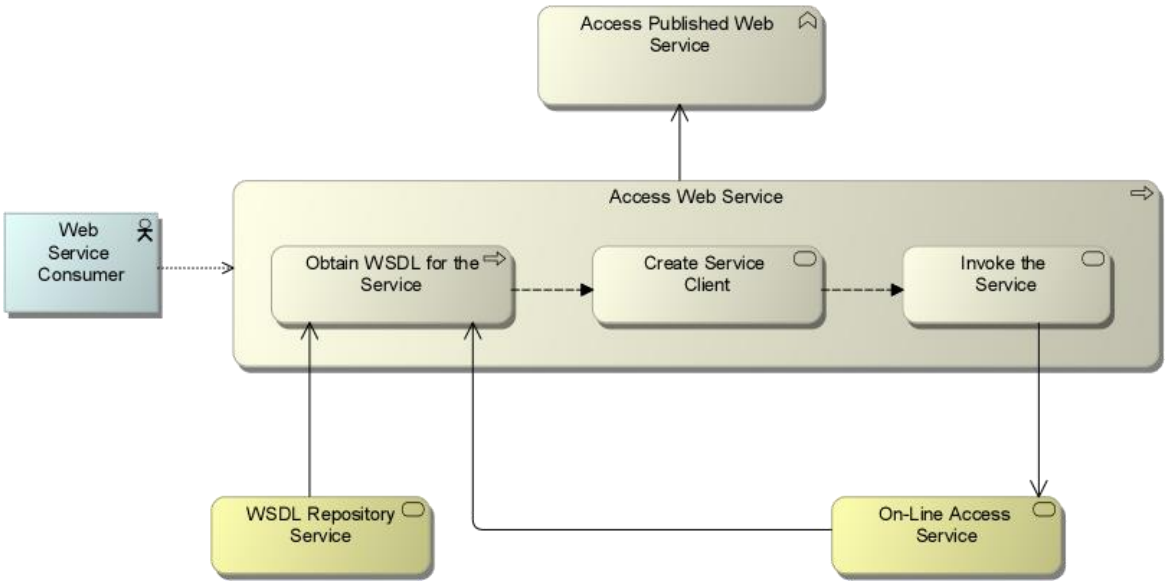

Figure 2-7 Accessing Published Web Service Scenario

Note that the two processes shown above make use of two application-level services, namely the WSDL Repository Service (for accessing the contract describing the service), and the On-Line Access Service (for consuming the service itself).

2.6 Components for eGov Solutions

This section identifies Architectural Components needed for eGov Solution for each of the previously described Usage Scenario types. Note that there are no components which are specific to eGov solutions as such; rather, realization of a given usage scenario requires a collection of standard, non-eGov specific components, most of which also appear in other CEAF Reference Architecture documents. In the subsections that follow, the components that provide for common aspects of security (such as Authentication, Authorization, or SSO), have been omitted).

2.6.1 Components in the Publish Scenario

The following figure shows components needed for realization of possibly the simplest interaction in the Publish Scenarios for an eGov solution.

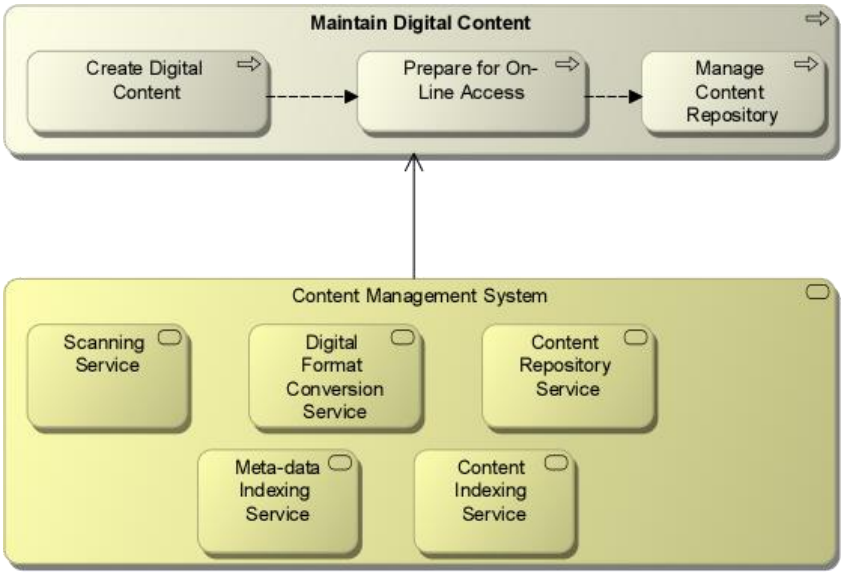

Figure 2-8 Components for Maintaining Digital Content in the Publish Scenario

In most enterprise scenarios, acquisition and maintenance of digital content will be responsibility of a dedicated solution – an Enterprise Content Management system – rather than a collection of after-the-fact integrated heterogeneous components. The following table summarizes responsibilities of the application-level components shown in the above figure:

Table 2-3 Responsibilities of Components for Maintaining Digital Content

Component	Responsibilities	Notes
Scanning Service	Convert physical media into their digital representation	Producing multiple target formats is not responsibility of the scanning service.
Digital Format Conversion Service	Provide for automated conversions between different digital media formats, or between the same media formats with different encoding parameters.	Extraction of one media type from another is also possible when needed (e.g., extracting audio from video or pictures from documents).
Content Repository Service	Support CRUD (Create-Update-Retrieve-Delete) operations on digital media.	Controlling access to the media (as assets) is not responsibility of this service.
Indexing Services	Index the contents of the repository to facilitate searches on media metadata and (where possible) the contents of the item.	Some types of media (e.g., audio and video) are not easily searchable on their contents.

The figure below shows services and components involved in providing on-line access to digital assets:

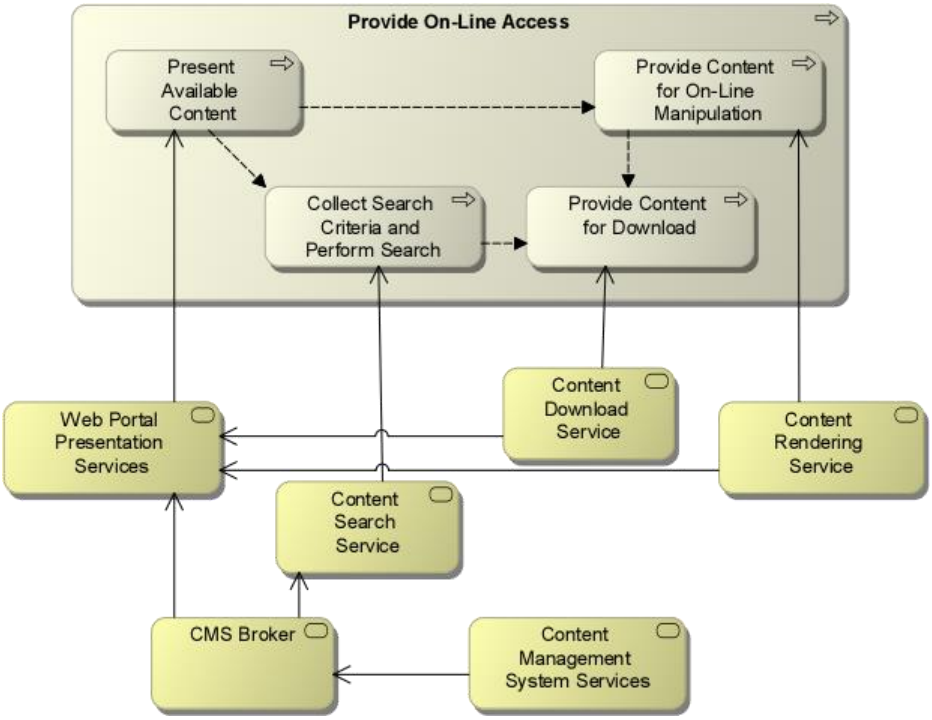

Figure 2-9 Services and Components for Providing On-Line Access in the Publish Scenario

The following table summarizes responsibilities of the application-level components shown in the above figure:

Table 2-4 Responsibilities of Services and Components for Providing On-Line Access

Component	Responsibilities	Notes
Web Portal Presentation Services	Assemble presentation of disparate content sources into a single presentation available to the user.	Key APIs in portals are standardized.
Digital Content Search Service	Provide for searching digital data content, using physical properties of the content and its available metadata.	
Content Download Service	Make the digital content available for download using a web browser.	Controlling access to the media (as assets) is not responsibility of this service, but rather delegated to the IdAM solution.
Content	Represent a given type of media in a manner	For example, a digital

Rendering Service	appropriate for the context.	document may need to be represented as a preview picture; multimedia content as specific part of it or some other representation.
Content Management System (CMS) Services	Manage (provision/de-provision, configure, monitor, etc.) services made available by existing instances of CMS.	
CMS Broker	Route requests to the proper Content Management System depending on the type of request or its scope.	Applicable to federated/multiple CMS instances.

2.6.2 Components in the Interact Scenarios

Interact Usage Scenarios for eGov group Business Processes in which asynchronous (typically) or synchronous interaction with the service Consumer is required. In case of the asynchronous interactions, the applicable mechanisms include email and collecting inputs from Consumers using web forms or more specialized solutions like wiki servers or forum servers. The synchronous interaction means, in case of eGov solution, some form of an on-line chat or dialog; however, this capability is not frequently encountered in the existing eGov solutions.

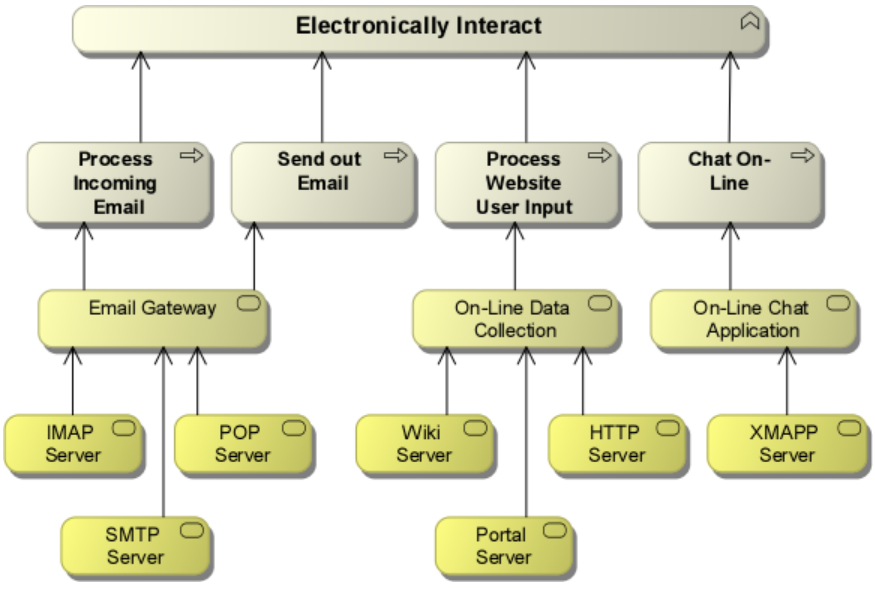

Figure 2-10 Components of a eGov Solution for Interact Scenarios

The following table summarizes responsibilities of the components identified in the above figure:

Table 2-5 Components and Their Responsibilities for the Interact Scenarios

Component	Responsibilities	Notes
Web Server	Process standard http(s) requests	API is standardized.
IMAP Server	Process and store incoming emails	POP server provides for similar functionality, but without ability to retain emails on the server. API is standardized.
SMTP Server	Process outgoing emails	API is standardized.
Wiki Server	Allow for controlled editing of specific web pages (or their parts) in a given web site	The editing in wikis is typically sufficiently simplified to be done by non-technical users.
XMPP Server	Support basic synchronous on-line messaging and routing	XMPP stands for “Extensible Messaging and Presence Protocol” and is defined by a number of RFC specifications (API is standardized).
Persistent Store	Durably persist the data	Depending on the component in question, either file system or a database is used; even though relational databases may be most common, other (non-relational) types of databases can be used.

2.6.3 Components in the Transact Scenarios

The following figure shows service-level components in a sample Transact Scenario – Process Application:

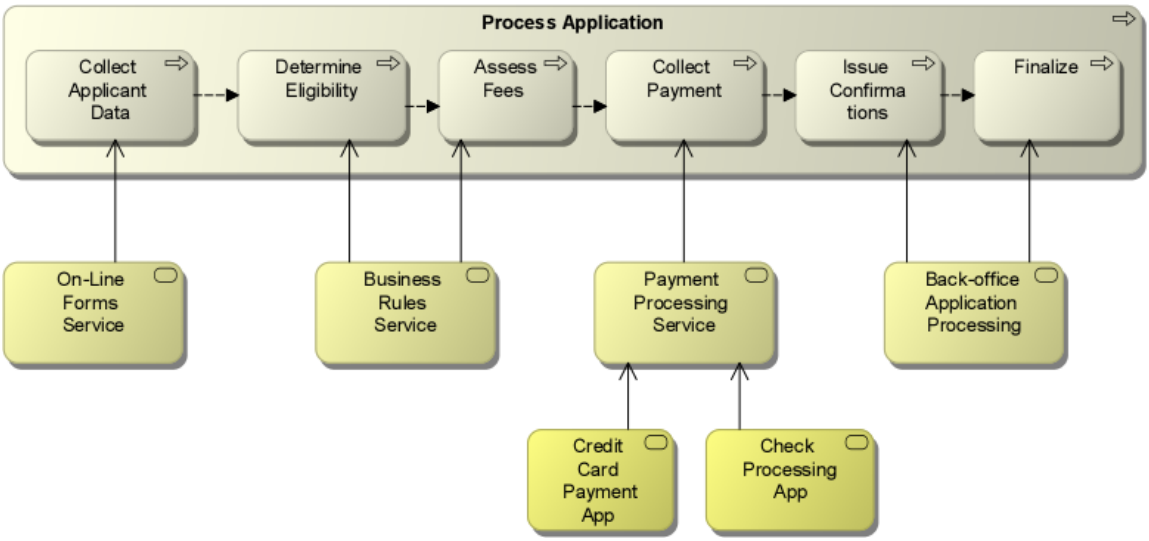

Figure 2-11 Components of a eGov Solution for Transact Scenarios

The following table summarizes responsibilities of the components identified in the above figure:

Table 2-6 Components and Their Responsibilities for Transact Scenarios

Component	Responsibilities	Notes
On-Line Forms Service	Provide for storing and on-demand retrieval of pre-defined input forms to be used to capture information from the user. Provide for a mechanism to validate the input and to flag validation violations.	The Service can be a component of a broader Content Management System
Business Rules Service	Provide for management and accessing of standardized business rules (conditions, constraints, ECA rules, etc.) to be used in the execution of Business Processes (e.g., when, deciding business process flow or performing business validations).	Service can be realized as a dedicated application or be a part of larger enterprise platform (EDM, or Enterprise Decision Management) and use a Business Rule Engine.
Payment Processing Service	Provide for reliable handling of payments from users, including ability to issue confirmations and/or invoices.	Dedicated components responsible for processing of specific payment type (e.g., by credit card, check, cash, etc.) can be used.

Back-office Application Processing	Encapsulates the existing part of the application processing Business Process that must be performed in order to complete the process, and which does not require immediate interaction from the on-line service user.	Transactional constraints are typically enforced by this type of component, unless the execution of the business process is itself supported by a business process engine with transactional capabilities.

3 eGov Reference Architecture Description

This section provides a description of eGov Reference Architecture (RA) using Conceptual and Logical Views, which provide an overview of relationships and interactions between components in an eGov solution for three main eGov scenarios.

3.1 Conceptual Views of eGov RA

There are a number of ways reference architectures for eGov can be represented at the conceptual level. This section describes, first, the conceptual view of Digital Services as produced by the Digital Government initiative (see [ii]). Next is presented a more elaborated view of eGov, which is based on the CEAF SOA Reference Architecture.

3.1.1 Digital Government Conceptual View

The Digital Government initiative (see [ii]) strives to provide a model of Digital Services that represents "a fundamental shift from the way our government provides digital services today". The intended shift is based on adoption of the following principles:

- Adopting the *Information-Centric* approach that is intended to enable a shift from managing "documents" to managing discrete pieces of open data and content which can be presented and delivered in the way that is most useful for the consumer of that information.
- Adopting the *Shared Platform* approach that is meant as a shift away from silo solutions towards sharing and/or reuse of solutions within and across agencies.
- Adopting the *Customer-Centric* approach that represents a shift towards customers shaping the delivered content and the way of delivering it "whenever and however they want it".
- Adopting the platform of *Security and Privacy* to ensure the safe and secure delivery and use of digital services to protect information and privacy.

The resulting model contains the following layers:

- The ***Presentation Layer*** defines the manner in which information is organized and provided to customers, and it included various channels of delivery to consumers of information.
- The ***Platform Layer*** includes all the systems and processes used to manage this information, including web API and application development, services that support mission critical IT functions such as human resources or financial management, as well as the hardware used to access information.
- The ***Information Layer*** contains digital information – both structured and unstructured, with the latter taken to mean "content, such as fact sheets, press releases, and compliance guidance".

The following figure shows the model of Digital Services for the Digital Government:

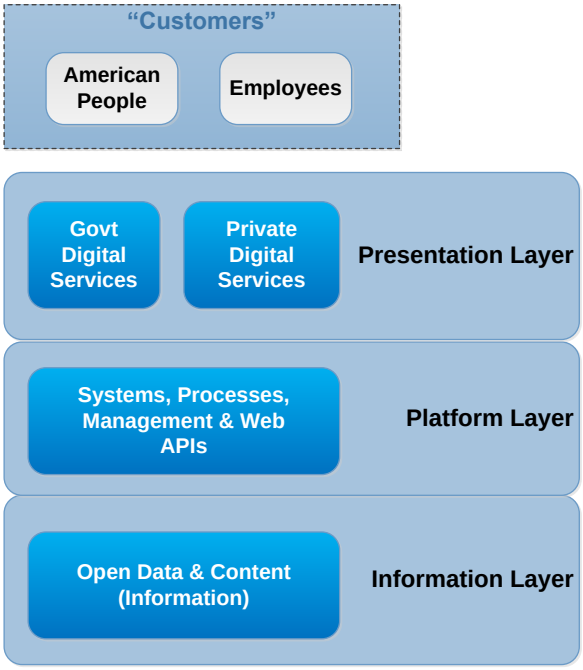

Figure 3-1 Digital Services Model in Digital Government

The above model focuses on the separation between creation of information, delivery of information, and the underlying mechanics (that is, the platforms) for achieving both. This conceptual overview of Digital Services for eGov is presented a very high level. CEAF 2.0 provides a more detailed conceptual architecture that is described in the following subsection.

3.1.2 CEAF Conceptual View of eGov

Reference Architecture for eGov depends on the remaining Reference Architectures published as part of CEAF 2.0. First of all, it is the SOA RA that provides the foundation for all other reference architectures in CEAF. Secondly, IdAM and EAI reference architectures provide crucial underlying capabilities for eGov solutions. Moreover, Enterprise Content Management (ECM) and Master Data Management (MDM) Reference Architectures provide for solutions directly relevant to eGov. Consequently, the approach to eGov architecture is informed in CEAF by the following facets:

- Adoption of SOA (understood as models for business and architectural domains)
- Reliance on capability-providing platforms (including IdAM and EAI platforms)
- Specific layering of components that comprise the eGov solution.

The following figure provides an overview of the eGov solution architectural context: it emphasizes the underlying platforms (designated by letters A to E) and the layers (designated by numbers, 1 to 5).

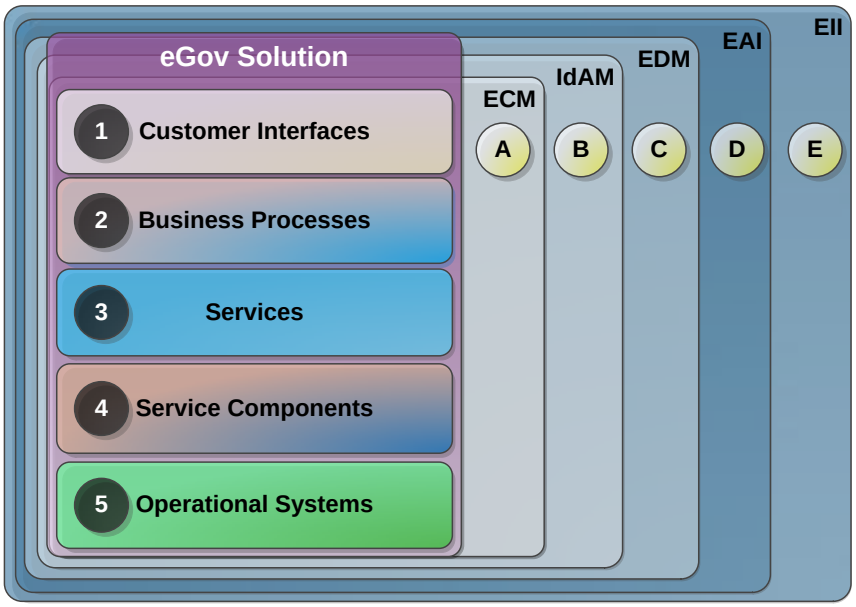

Figure 3-2 eGov Solution Architectural Context

The above figure shows the SOA-based layers, described in the following table:

Table 3-1 SOA-based layers in eGov Solution

Label	Description
1	Customer Interfaces Layer, which provide users with appropriate channels of interacting with the information systems in the organization.
2	Business Processes Layer, which define functional workflows that support business activities in the organization.
3	Services Layer, which provides units of functionality, specified by contracts about the interaction, and expressed as APIs or interfaces.
4	Service Components Layer, which are actual components implementing one or more services.
5	Operational Systems Layer, which provides execution environment for Service Components and technical facilities required by them, including applications, subsystems and their infrastructure.

The capabilities of the above components are enabled by the underlying platforms, which are described in the following table:

Table 3-2 Enabling Platforms in eGov Solution

Label	Description
A	***Enterprise Content Management*** (ECM) Platform, which provides for managing the lifecycle of digital assets and their publishing using standard channels.
B	***Identity and Access Management*** (IdAM) platform, which is responsible for identity and protected resource provisioning, authentication and authorization, single sign on and single log off, and similar functions.
C	***Enterprise Decision Management*** (EDM) Platform, which supports defining of business logic in application-agnostic terms and a standard way for accessing and evaluating it in business processes, and service components.
D	***Enterprise Application Integration*** (EAI) Platform, which provides for standard transformation of data and protocols for business processes and service components.
E	***Enterprise Information Integration*** (EII) Platform, which provides for integration of data and metadata required for business processes and services.

3.2 Logical View of eGov RA

The Logical Views of eGov RA bring together all major components of an eGov solution that have been described separately in the Section "Components for eGov Solution" earlier in the document. The diagrams presented reflect distinct *types* of scenarios applicable to eGov solutions:

- Publish scenarios, in which Enterprise Content Management Platform is the focal platform (in addition to IdAM)
- Interact and Transact scenarios, which emphasize execution of workflows and business processes and Enterprise Application Integration platform.
- Integrate scenarios, which bring to the fore interoperability as supported by Enterprise Information Integration (EII) platform.

3.2.1 Publish Scenario Logical View

The following figure shows a logical view of eGov solution that realizes the Publish Scenario, as described in the section "Publish Usage Scenario":

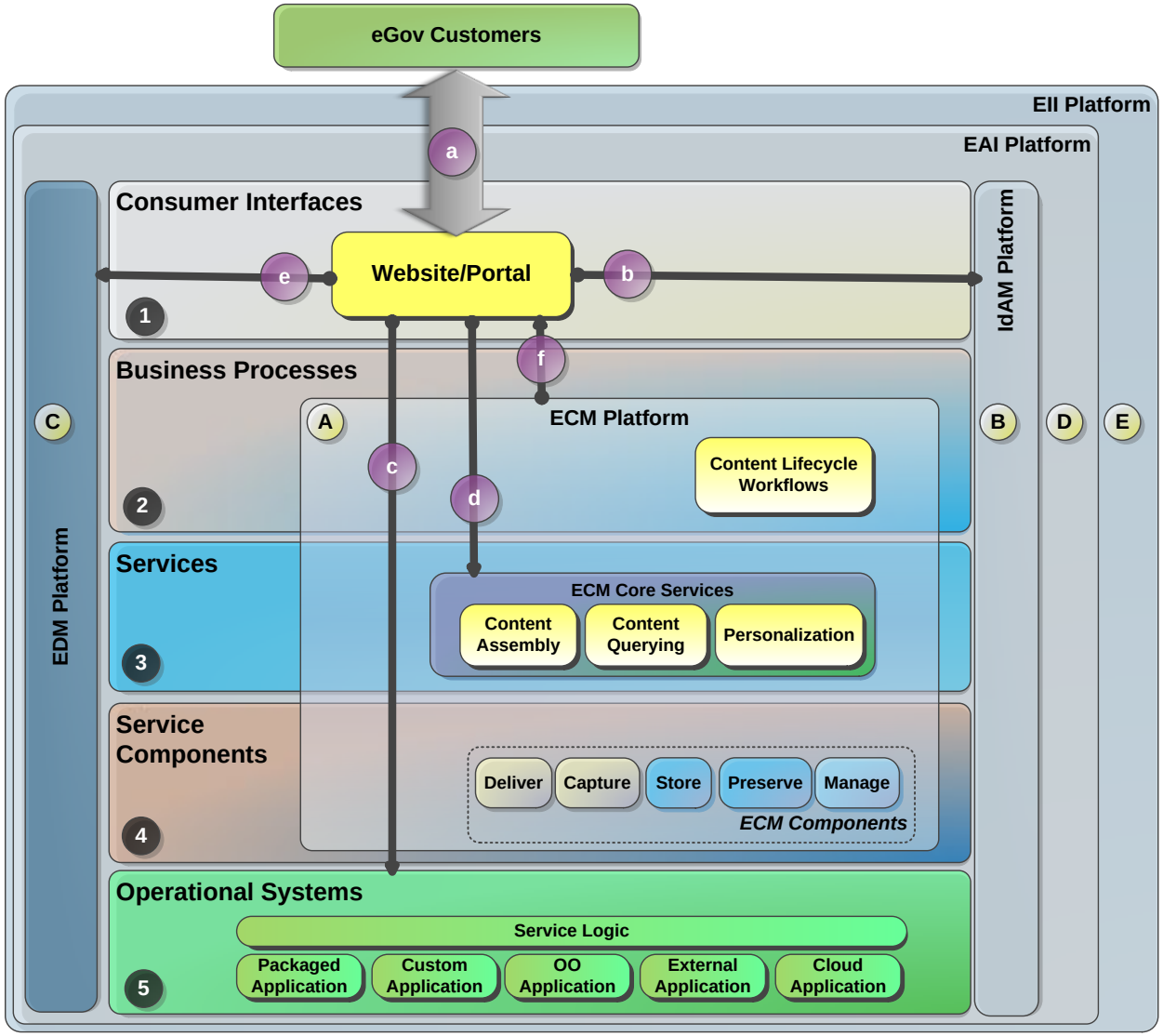

Figure 3-3 eGov Publish Scenario Logical View

In the above figure, labels A-E and 1 to 5 have the same meaning as in the *Figure 3-2 eGov Solution Architectural Context*. Labels (a) to (f) are described in the following table:

Table 3-3 Key Interactions in the Publish Scenario

Label	Description
a	eGov user interacts with the eGov solution by connecting to a web site or an eGov portal over internet or intranet.
b	The Website/Portal component uses authentication and authorization functionality as provided by the IdAM platform.
c	The Website/Portal component makes available the content that it obtains either from operational systems directly,
d	Or by using ECM Services, in order to query for content, or assemble the content from multiple sources, or access user/group-specific personalization data.
e	The Website/Portal component may use business rules as supported by the EDM Platform.
f	When an ECM Platform present in the solution supports its internal content lifecycle workflows, the platform is also a provider of content to the Website/Portal component.

3.2.2 Interact and Transact Scenarios Logical View

The following figure shows a logical view of eGov solution that supports the Interact and Transact Scenarios, as described in the section “Interact Usage Scenarios” and “Transact Usage Scenarios” respectively. Note the prominence of Business Processes in both kinds of scenarios – regardless of the complexity of a business process in question, both types of scenarios rely on a definition of a business process, and – on a logical level – they execute it. In the logical view, the extent of automation of the business process is not the fundamental difference. The two scenarios may differ in complexity of the executed business processes (with the Transact scenarios supporting typically complex cases), but they do differ in their support of transactional processing (typically absent in Interact scenarios, and mandatory in Transact scenarios).

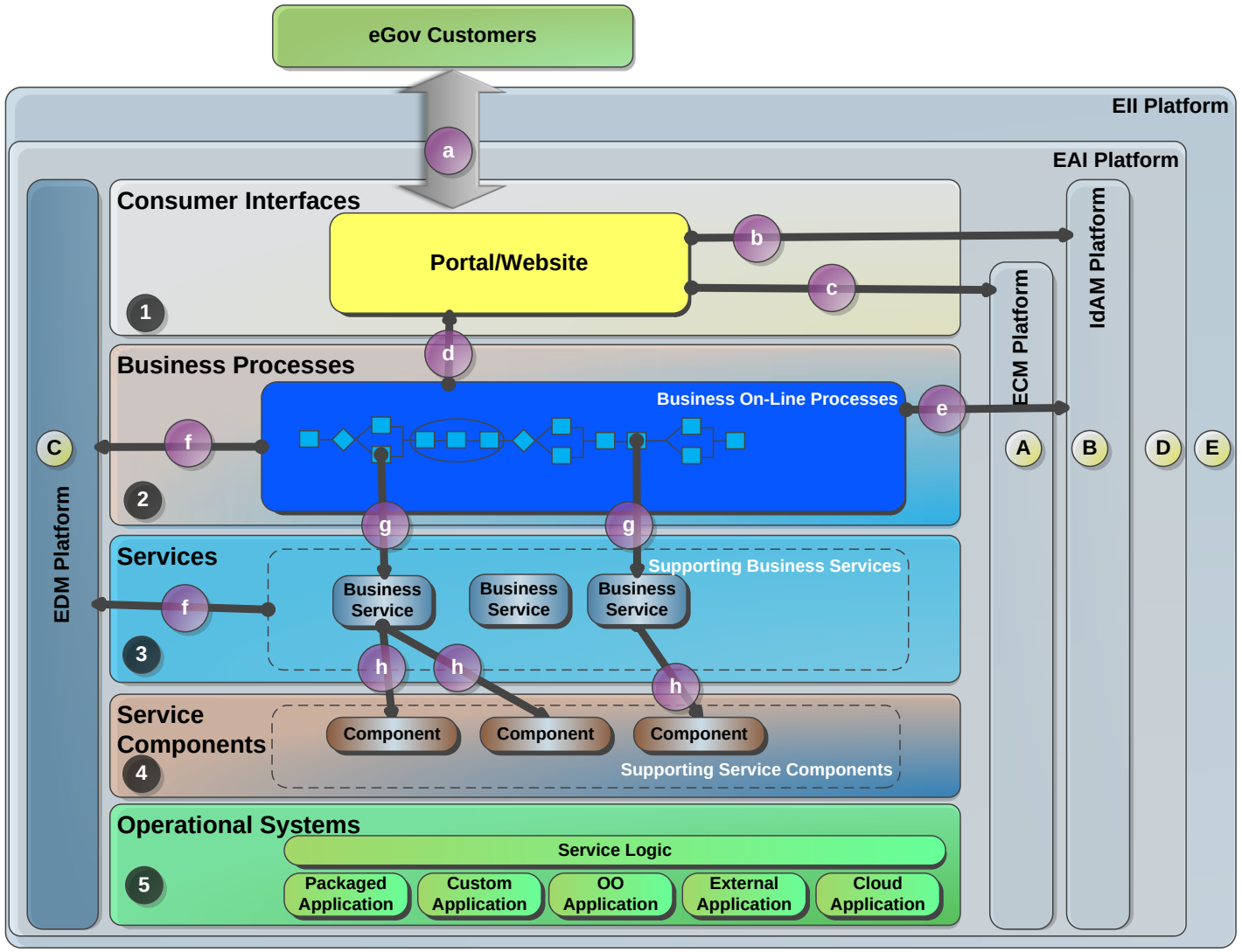

Figure 3-4 Logical View of Interact and Transact Scenarios in eGov RA

In the above figure, labels A-E and 1 to 5 have the same meaning as in the *Figure 3-2 eGov Solution Architectural Context*. Labels (a) to (f) are described in the following table:

Table 3-4 Key Interactions in the Interact and Transact Scenarios

Label	Description
a	eGov user interacts with the eGov solution by connecting to a web site or an eGov portal over internet or intranet.
b	The Website/Portal component uses authentication and authorization functionality as provided by the IdAM platform.
c	The Website/Portal may need to obtain some elements of the presented content – such as personalization-related elements - from the ECM platform.
d	Once a business process is started by the user in the browser, it is the executing business process instance that takes over the control of the interaction with the user and of orchestration of interactions with internal services.
e	During the execution of a business process, some of the steps of the process can be required to interact with the IdAM platform for access control – e.g., to determine if particular user is authorized to perform a given step or operation, or if specific information is accessible to the user.
f	Interactions with the EDM platform, in order to evaluate common/externalized business rules, can take place both during the execution of business process instances (and its internal steps) and when a given service is executed.
g	Steps in the executed business process instance interact with services as prescribed in the business process definition.
h	Executing services, in turn, interact with one or more service components. It is then component's responsibility to interact with EAI, EII platforms or with Operational Systems directly.

3.2.3 Integrate Scenario Logical View

The following figure shows a logical view of eGov solution that supports the Integrate Scenarios, as described in the section "Integrate Usage Scenarios".

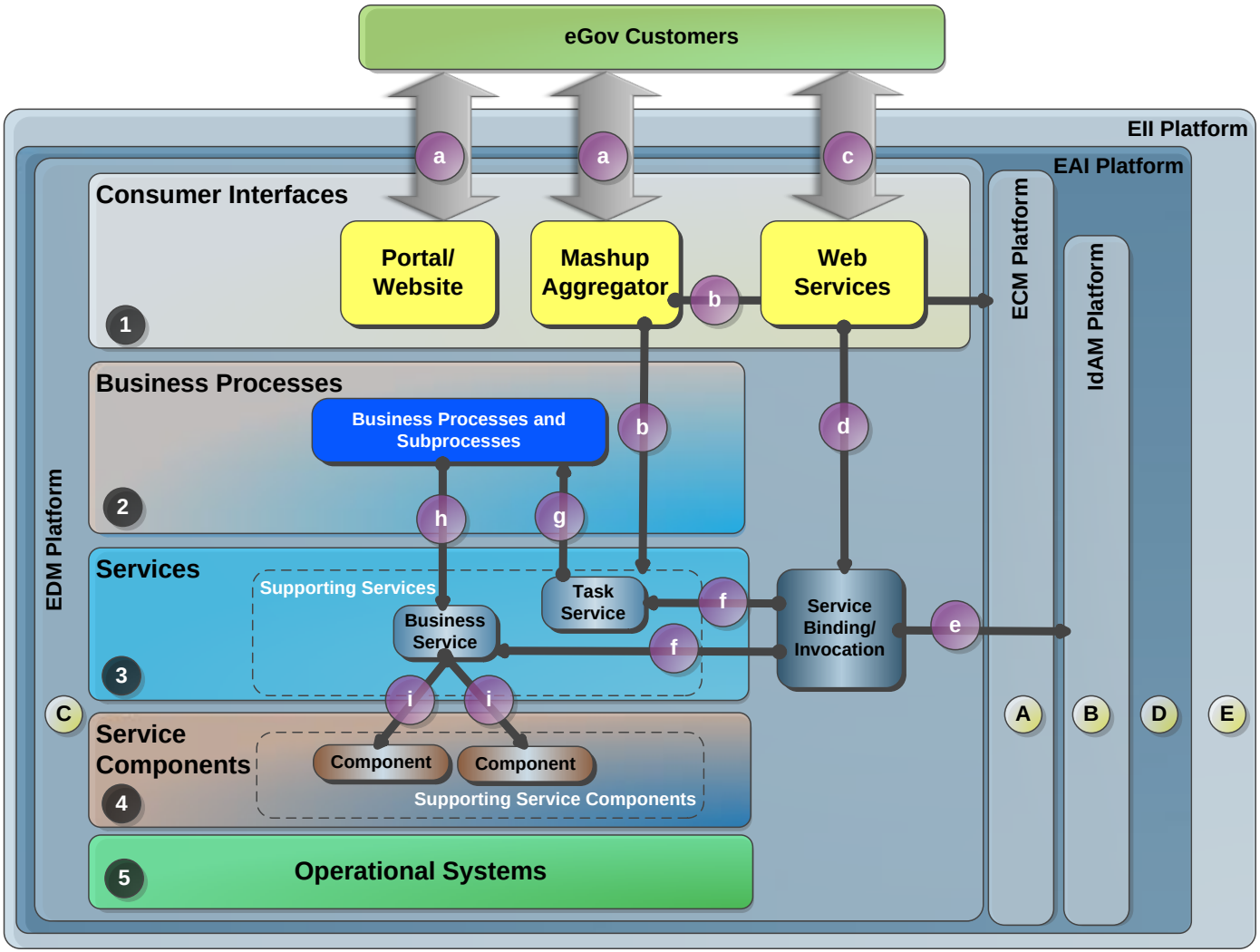

Figure 3-5 Logical View of Integrate Scenarios in eGov RA

In the above figure, labels A-E and 1 to 5 have the same meaning as in the *Figure 3-2 eGov Solution Architectural Context*. Labels (a) to (f) are described in the following table:

Table 3-5 Key Interactions in the Integrate Scenario

Label	Description
a	eGov user interacts interact with the eGov solution by connecting to a web site or an eGov portal over internet or intranet. From the user's perspective, there is no difference between accessing a web site or portal or a mashup.
b	Mashup aggregator accesses the ECM platform and/or dedicated services for the content to be aggregated. The accessed and aggregated content can be located in intranet, extranet or internet.
c	eGov user (typically, not a human) consumes eGov-provided Web Service.
d	The requested service is obtained from a registry, bound and invoked by a dedicated component.
e	Invocation of the actual service involves access control using the IdAM platform.
f	The executed service is either a simple service that directly uses service components, or a "task service", which triggers execution of a business process or of a part of one ("sub-process").
g	The executed task service triggers execution of a predefined business (sub) process.
h	A step executed in the (sub) process instance invokes corresponding service.
i	The service interacts with service components in a predefined (and encapsulated) way.

4 Implementation Notes and Guidelines

This section is intended for implementation notes and guidelines pertaining to eGov. This section is expected to evolve over time, using contributions from practitioners.

The initial topic is eGov Maturity Models, discussed from the point of view of lessons they offer for eGov and for Enterprise Architecture initiatives related to eGov.

4.1 Lessons from eGov Maturity Models

There has been a number of eGov Maturity Models proposed since the early 2000's. These models attempt to characterize distinct "stages of growth" in eGov solutions and reflect experiences with evolution of eGov. To the Enterprise Architect, eGov Maturity Models can be valuable because they provide generalizations of industry experiences when implementing eGov solutions over a period of time. The following table provides a summary of the most popular models.

Table 4-1 Summary of eGov Maturity Models

Source	Stages in the Model
Gartner (2000)	(1) Web Presence; (2) Interaction; (3) Transaction; (4) Transformation
UN (2001)	(1) Emerging; (2) Enhanced; (3) Interactive; (4) Transactional; (5) Integrated
Deloitte (2001)	(1) Information publishing/dissemination; (2) Official two-way transaction; (3) Multi-purpose portals; (4)Portal personalization; (5) Clustering of common services; (6) Full integration and enterprise transaction
Layne and Lee	(1) Catalogue; (2) Transaction; (3) Vertical Integration; (4) Horizontal Integration
Hiller, Belanger, Moon (2001/2)	(1) One-way dissemination; (2) Two-way communication; (3) Service and financial transaction; (4) Vertical and horizontal integration; (5) Political participation
Siau and Yong (2005)	(1) Web Presence; (2) Interaction; (3) Transaction; (4)Transformation; (5) E-democracy

The above models have a number of common elements, and they differ one from another in the number and scope of the stages identified. Despite their differences, they indicate the following:

- Successful implementations of eGov follow identifiable subsequent stages. Each of the stages is characterized by specific capabilities that it provides. Each of the stages faces typical challenges that are not limited to the technical ones, but rather they involve functional and organizational dimensions that may become critical to the success or failure.

- Reaching a given, non-initial stage of maturity in eGov implementation typically requires providing capabilities required for the preceding stage. For example, before supporting life event-centered interaction between eGov and its users, a significant chunk of vertical and horizontal integration needs to take place to make this possible.
- Creating a working eGov solution involves, in addition to technical and architectural challenges, organizational challenges. This is already visible in simple eGov initiatives when it comes to determination of respective organizational responsibilities for developing and for maintaining digital content. The organizational challenges only grow when capabilities needed for eGov require collaboration among a number of organizations.
- Creating EA Roadmap should take into consideration discrete stages of growth of eGov services, using lessons provided by eGov Maturity Models. In other words, targeting high maturity stage in an eGov initiative without gradual reaching of initial maturity stages is problematic.

Let us consider the Layne-Lee eGov Maturity Model as an example to illustrate functional, organizational and technical challenges for each of the stages. The model distinguishes the following eGov stages:

- Stage 1: ***Catalogue*** stage provides read-only access to digital assets provided by the government, typically electronic or digitized documents, including forms.
- Stage 2: ***Transaction*** stage supports bi-directional interaction between the service provider and the customer when it comes to collection of information or payments.
- Stage 3: ***Vertical*** Integration stage involves integrating systems providing at different levels of the government (e.g., local, state, and/or federal levels) which provide similar or closely related functions.
- Stage 4: ***Horizontal*** Integration stage involves integration of systems across different functions in order to provide one stop entry point for the user; this stage usually involves transforming existing processes and procedures with a view of directly supporting eGov.

In the above model, subsequent stages represent both increasing levels of integration and increasing organizational and technological complexity. The following tables summarize typical functional, organizational, and technical challenges for each stage in the model.

Table 4-2 Challenges in the Catalogue Stage

Stage	Typical Challenges
Functional	• The services at this stage have typically limited value to the Customer. • Gradually, some form of integration with other governmental sites becomes needed – this typically takes form of “on-screen” integration and creation of clearinghouses for particular domain of interest. However, this form of integration tends not to simplify interactions of the Customer with the government, because it maintains and exposes organizational divisions that are of no interest to the final consumer of the service.
Organizational	• Assignment of responsibility for managing new services (responsibility by a single organization, shared responsibility, outsourcing, etc.)

	• Simple forms of collaboration are required with other organizations that make their catalogues available on-line.
Technical	• With the growing amounts of information provided, search and metadata capabilities are required. • With growing amounts of digital assets made available, there is a growing need for adopting an ECM, in order to manage in an orderly way the lifecycle of digital assets and in order to automate this management. • Providing reliable security services (Identity and Access Management) is likely to become increasingly problematic in over time. For example, providing for Single Sign-On is not feasible without some form of integration with a wider security platform. • Ability to integrate with existing systems is limited. • Ability to scale is often limited.

Table 4-3 Challenges in the Transaction Stage

Stage	Typical Challenges
Functional	• Providing for reliable way of collecting information from the users (e.g., when they fill out forms on-line) • Reliably supporting payments on-line
Organizational	• Assignment of responsibility for fulfillment of on-line orders; the fulfillment can be internal, outsourced, or mixed. • Supporting functions may require inter-departmental collaboration or external dependency on an outsourced service. In either case, the number of organizational dependencies – and consequently, the complexity of the solution- increases.
Technical	• Providing for transactionally reliable processing, typically using a mix of legacy systems, new components, and external services (e.g., payments) • Providing for scalable and flexible solution, capable of meeting spikes in demands for the service (such as spikes in payment close to the cut-off date).

Table 4-4 Challenges in the Vertical Integration Stage

Stage	Typical Challenges
Functional	• Re-conceptualization of existing or legacy services may be required to support further evolution of eGov • Removal of functional walls (e.g., between licensing and customer/vendor systems) is eventually needed.
Organizational	• Organizational changes reflecting functional and technical adjustments to supporting eGov directly • Making collaboration between various levels of government possible. • Determining the scope of applicable jurisdictions and responsibilities.
Technical	• Integration of various systems at different levels (municipal/local, state, federal) emphasizes workable integration strategies and explicit common approaches. • Communication infrastructure becomes a critical factor for the success of vertical integration.

Table 4-5 Challenges in the Horizontal Integration Stage

Stage	Typical Challenges
Functional	• Determining functional scenarios centered around “life-event approach” or an equivalent user-centric perspective • Transforming the existing processes to support horizontal integration
Organizational	• Determining the roadmap for the functions to be horizontally integrated • Overcoming the existing functional specialization embedded in the organizational structure of governments • Planning and coordination in inter- and supra-departmental/agency efforts
Technical	• Introducing cross-organizational technical interaction and interoperability • Reuse of solutions for key technical components, eventually leading to standardization of patterns and components in the adopted technical solutions.

5 Glossary

311 is the federally approved phone number for the call center that provides non-emergency public services.

Application Architecture is architecture that defines the major applications or service components needed to manage data and support business functions.

Architecture is a set of design artifacts, or descriptive representations, which is relevant for describing an object such that it can be produced to requirements (quality) as well as maintained over the period of its useful life (change). [John Zachman & adopted by the Federal Chief Information Officer Council]

Content Management Platform (CM) is a set of tools and processes to manage acquisition, distribution, conversion and archiving of digital documents (potentially including multimedia assets) in an organization, usually in context of web content, knowledge management, e-commerce, and similar areas.

Citizen Relationship Management (CiRM) is a variation of CRM adjusted for interactions between government and citizens. In contrast to CRM, CiRM is focused on encouraging citizen participation rather than making them profitable.

Customer Relationship Management (CRM) is technology-enabled management approach with the objective to start, maintain, and make customers more loyal and profitable. Effective CRM requires a shift to customer-centric culture to support marketing, sales, and services.

Enterprise Decision Support Platform (EDS) are enterprise-level systems for managing extraction, flow, and lifecycle of information to enable decision makers to implement desired strategies.

ICT is an abbreviation for “Information and Communication Technology”, which is a superset of Information Technology (IT).

Mashup is an assembly of existing software and data services into new Web-based solutions. There are two types of mashups: browser-based, with assembling taking place in the web browser, and server-based.

Portal is a system providing users with easy-to-use, personalizable and secure access to information, applications, organizations and/or individuals. In general, portals can be accessed using different access channels and media, but in practice, “portal” typically means “web portal”, where the main or only channel of access is using the World Wide Web (WWW).

Reference Architecture models the abstract architectural elements in the domain independent of the technologies, protocols, and products that are used to implement the domain.

Service Component is an actual application, program or subsystem providing implementation of a Service treated as a contract.

Service Delivery is a process that comprises all activities involved in providing a service to the consumer of the service.

Web Service is a software component that can be accessed by another application (such as a client, a server or another Web service) by using generally available protocols and transports (such as HTTP).

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7 Document History

Table 7-1 Document History

Release	Description	Date
Version 1.0 Draft	Initial creation	06/19/2013
Version 1.0 Second Draft	Revised based on internal review comments	08/07/2013
Version 1.0 Final Draft	Addressed EAC review comments	10/23/2013
Version 1.0 Final	Final version	01/02/2014