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ARCHITECTURAL APPROACH: A CONCEPTUAL FRAMEWORK FOR THE NATIONAL INFORMATION SYSTEM OF THE STATE OF KUWAIT

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Key Words

Architectural Approach; Architectural Framework; Zachman Framework; Conceptual Design; National Information System.

Abstract

The National Information System (NIS) for the State of Kuwait main objectives are to acquire, organize, make accessible, and preserve the national and cultural heritage of the country. A complex and diversified system, like NIS, requires an architectural framework. Zachman Framework (ZF) [Zachman, 1987, 1997], a widely known and used framework for enterprise information system architecture will be adopted to represent the NIS. The paper discusses only the conceptual architectural view of NIS which should communicate to the designers, implementers, operators and users a consistent view of the system.

Introduction

The mission of the National Information System (NIS) for the State of Kuwait is to acquire, organize, preserve the national heritage and culture of the country and make them accessible to users of all kinds. Its mission is also to provide information services for research, education, decision support, business and commerce, and general public education. NIS's mission is also to provide the same set of services covering the Gulf States, the Arab and Islamic countries though in much less detail.

NIS concept presented herein is described within the context of Kuwait National Library System

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(KNLS) and its mission can best be expressed in terms of its goals. These goals are defined as follows:

* Establish documented agreements with other information centers in Kuwait that will define a National Library System with agreed upon collection development and acquisition policies, bibliographic standards, indexing and abstracting standards, preservation and archive standards, automation standards, networking standards and information access policies.

* Build a comprehensive collection of documents and other information artifacts which preserve the national heritage, literature, social, political, scientific, religious, economic and other endeavors for Kuwait, the Arabian Gulf, the Arabian Peninsula and the Islamic and Arabic civilization. Some of this collection will be housed in the National Library itself while some will be housed in other libraries that are part of the National Library System.

* To utilize the most modern information processing and network technologies and techniques available to acquire, organize, catalog, classify, index, abstract, preserve, archive, manage, store, retrieve and deliver information for the National Library and a National Library System.

* To promote and establish standards for bibliographic descriptions, cataloging, classification, subject headings, transliteration, indexing, abstracting, publishing, electronic record formats, networking, privacy, security and access to information.:

* To promote and develop bibliographic tools that will aid the National Library, other libraries in Kuwait, libraries in the region and libraries in other Arab countries as well as the world in processing Arabic and Islamic information in a usable, consistent and accurate manner.

* To provide an array of integrated information services for end-users and other libraries whose scope and quality are world class.

* To act as a coordination center for establishing a national information system that minimizes duplication of acquisitions but provides universal access to information for all authorized users.

* To develop and promote the educational programs for information professionals who can plan, manage and operate information systems using standard practice and the most modern technologies and methods.

* To promote the production of literary works for children and adults that document the national heritage of Kuwait, the Arabian Gulf, the Ara-

bian Peninsula and the Islam and Arab civilization.

* To take a leadership role in developing national information policies

* To design and operate a physical facility for the National Library which supports all library functions, the preservation of rare artifacts and culture, and the distribution of information in electronic form using telecommunications and networking technologies.

A nation-wide information system with such magnitude and complexity can not be designed and built in a consistent manner without a framework constructed based on a set of principles that provide constraints as to how information resources can best be acquired, structured, processed, managed, accessed and disseminated. that identifies the components of such a system relevant to its mission, laws and procedures, human resources, content, tools, standards, preservation, access mechanisms, security and technical infrastructure.

This paper presents a macro level description of a national information system for the state of Kuwait based on an architectural framework. The framework used is Zachman Framework [Zachman, 1987, 1997], a widely used framework for describing information system architecture. As Zachman framework covers architecture from various perspectives or views, the focus of this paper is to present NIS from the conceptual perspective or view. The article also discusses the need for a philosophy defined by a set of architectural principles that can act as the basis for the design of NIS.

Overview of the National Information System Concept

Most software today is still produced using a custom-crafted approach. Many frameworks, toolkits, and collections of reusable components are becoming available for constructing software applications, but are not widely used. Consequently, systems continue to be expensive to design and build, often take longer to develop than they should, and often do not fully satisfy the business user's needs. Recent developments have focused on improving the design and development of software. As information systems become more complex, the overall system structure-or system architecture-becomes a central design problem. Design issues at this level include the high-level organization of the information system, its control and data structures, the assignment of functionality to logical and physical computational units, and the high-level interactions between these computational units. [Treasury Architecture Development Process Version 1.1]

Overview of the Architectural Framework

System architecting is a multidisciplinary approach for defining and developing an architecture for an organization (Rechtin 1992). The system architect is responsible for establishing a satisfactory and feasible system concept at the earliest stage of system development, for maintaining the integrity of that concept throughout development, and for certifying the fitness of the resulting system for use by the client or customer. System architecting is a process for describing information system architectures in sufficient detail to make them useful to develop information systems. It is driven by the need to satisfy the client's requirements. System architecting has several focuses described bellow.

Mission Focus: System architecting looks beyond the needs of a single information system. While traditional analysis focuses on solving a particular problem, system architecting looks across the business operations. By creating models describing an organization's business operations and the environment in which they operate, system architecting permits the specification of families of systems. By focusing the development methodology on the business operations, information systems functionality provided by the NISA can be aligned with the organization's missions.

Requirements Focus A constant challenge for information systems development is to come to agreement on system requirements-both at the business and functional levels. Gathering requirements is often difficult because discussions are vague and unbounded. Using the system architecture as a starting point, developers and customers limit their conversations to agreed upon levels of detail and areas of concern. Once consensus is reached on one level of requirements in one area, the analysis may either drill down to the next level of detail or move laterally to another set of concerns.

Development Focus A continuing challenge for information systems organizations is to ensure delivery of information systems that satisfy the business and functional requirements. An organization wants to be certain that the system, as developed, will conform to its requirements, and it wants to be able to reliably estimate and manage the work to be done. A system architecture guides both the requirements gathering and system development processes. Development projects progressively elaborate the architecture, adding more detail over time. When requirements and development share a common terminology and set of descriptions, there is an assurance that

the system, as constructed, will conform to the requirements. And because development is more elaboration than invention, planning and managing the work can be more reliable. Although problems may still arise.

Information System Architecture Principle

There is no commonly accepted definition for the term "information system architecture." However, the term "architecture" typically means structure, so an analogy can be drawn between the construction of buildings and the construction of information systems approach [Alexander, 1975, 1977, 1979;Spector, 1986; Rechtin, 1992; Hammer, 1990, 1993].

In this paper the following definitions are used:

An ***information system*** is a collection of functions, information, work organizations, and technologies that are integrated for the purpose of supporting and improving the day to day operations, as well as fulfilling the problem-solving and decision-making information needs.

An ***information systems architecture*** is a conceptual and coherent blueprint that describes the structure of information system components, their interrelationships, and the architectural principles and guidance governing their design and evolution over time in an organization.

An information system architecture includes a commonly accepted set of components that provide the building blocks for an information system. These building blocks and their attributes are defined at the appropriate level of detail to suit the needs of the planning decisions that are being made. For example, the architect of a town may be concerned with classes of residential, commercial, industrial, education, and recreational properties and the associated transportation and utility infrastructures to support them. An residential building architect is concerned with the architecture pertaining to the structure and use of the individual buildings in the context of how they are used. For example, the residential architect must be conscious of rules concerning disabled and handicapped persons, and the electrical, fire, and safety codes for the community.

There maybe several types of residential building architectures within the residential class. The components, by themselves, do not make an information system architecture. They must be integrated according to a set of well-defined relationships that describe how they will be used, their interconnection, the standards they must meet, access to the services they provide, and the utility services they

require. In the context of town planning, the town planner applies zoning by laws and building codes to ensure conformity with accepted principles and standards of construction. Architecting, however, is not just design and integration. Architects must also consider aesthetics.

Designing pleasing architecture is the artistic side of architectural planning. Thus, a town planner considers how to lay out streets that are attractive and discourage through traffic, how to hide utility services from view, and how to impose structural restrictions on builders to ensure that diversity of design and conformity to standards and building codes do not conflict. For example, the town planner must ensure that the public highways have a certain width that can easily accommodate public safety vehicles.

Architectural principles are statements of preferred direction or practice. They are simple, direct statements of how an organization wants to use information technology in the long term. They establish a context for design decisions in which business criteria can be translated into language and specifications that technology managers can understand and use in planning, designing, developing, and implementing of an information system. Each of the information system architecture principles is presented in this chapter with its rationale as well as the implications of its use.

The National Information System Architecture (NISA) is represented in terms of component architectures. A component architecture describes a logical or physical perspective of the NISA.

* The information architecture identifies, defines, and organizes all of the information needed to perform the NIS operations and the relationships among that information. All data needed to support business functions should be captured in the information architecture.

* The functional architecture identifies, defines, and organizes the business functions, processes, or activities that capture, manipulate, and manage the information to support NIS operations. It also describes the logical dependencies and relationships among KNLS functions.

* The work architecture depicts the decentralization of the NIS operations, the distribution of the work organizations to NIS locations, and the communication and coordination between these locations. It also describes the major operations performed by work organizations in support of functions and the types of work in terms of the type of workers and types of work location.

* The infrastructure consists of hardware and a set of services the applications use as they execute. Each of the service areas can be further described (out of scope of this document) in terms of a set of application programming interfaces (APIs) that may be specified by standards. Application programs invoke services through the APIs. Hardware is not further specified in this document because the objective of open systems is to promote hardware platform independence. The work, functional, and information architectures collectively model the NIS organization's operations.

Zachman Architectural Framework

The architectural framework utilized in this paper is Zachman Framework described in detail in (Zachman, 1987, 1997; Sowa, 1992). Zachman Framework as it applies to enterprise and information system architecture is a logical structure for classifying and organizing the descriptive representations of an enterprise that are significant to the management of the enterprise as well as to the development of the enterprise's systems. The framework was derived from analogous structures that are found in the older disciplines of Architecture/Construction and Engineering/Manufacturing that classify and organize the design artifacts created over the process of designing and producing complex physical products (e.g. buildings or airplanes.) The logic construct is a matrix comprised of perspectives/ views such as planner, owner, designer, builder, subcontractor, and user versus interrogatives/focus such as what, how, where, who, when, and why as shown in Figure 1. The meaning of Zachman Framework's perspectives are defined as follows:

* **Contextual (scope, planner):** The framework perspective that addresses the gross size and shape of the context setting architectural representations; the "planners" view.

* **Conceptual(enterprise model, owner:** The framework perspective that addresses the model of the enterprise or business architectural representations; the "owners" view.

* **Logical (system model, designer):** The framework perspective that addresses the model of the manual and automated information system architectural representations; the logical, "designers" view.

* **Physical (technology model, builder):** The framework perspective that addresses the model of the technology constrained architectural representations; the physical, "builders" view.

Figure 1
Zachman Architectural Framework

	What Data Entity-relation-ship)	HOW Function Process/ Input-Output	WHERE Network (Node/Line)	WHO People (Agent/Work)	WHEN Time (Event/Cycle)	WHY Motivation (End/Means
CONTEXTUAL SCOPE (Planner)	List of Things important to the business	List of Process the Business Performs	List of Locations in which the business Operates	List of Organizations Important to the Business	List of Events Significant to the Business	List of Business Goals/ Strategies
CONCEPTUAL Enterprise Model (Owner)	Business Entity Model	Business Process Model	Business Network Model	Business Workflow Model	Business Event Model	Business Strategy Model
LOGICAL System Model (Designer)	Logical Data Model	System Process Model	System Process Model	Human Interface Architecture	System Event Diagram	Business Rule Model
PHSICAL Technology Model (Builder)	Physical Data Model	Application Structure Chart	Network Technology	Presentation Architecture	Technology Event Diagram	Rule Design Model
OUT-OF-CONTEXT Components (Subcontractor)	Data Components	Program Components	Network Components	Interface Components	Event Components	Rule Specifications
FUNCTIONING ENTERPRISE	e.g. DATA	e.g. FUNCTION	e.g. NETWORK	e.g. ORGANIZATION	e.g. SCHEDULE	e.g. STRATEGY

* **Out-of-Context(components, subcontractor):** The framework perspective that addresses the out-of-context architectural representations; the "subcontractors" view.

* **Product (functioning enterprise):** The framework perspective that addresses the actual functioning system artifacts; the "users" or "customers" view.

Each perspective contains a complete view of the business and must therefore covers various focus areas, each of which answers a basic question: what = data; how = function; where = network; who = people; when = time and why = rationale. (Sowa and Zachman, 1992). The meaning of these focuses are defined as follows:

* **What(data, entity-relationship):** The framework focus that addresses what things are made of, that is, data or material; expressed as entity/relationship.

* **How (function, processing/input-output):** The framework focus that addresses how things function; expressed as process/input-output.

* **Where (network, node/line):** The framework focus that addresses where things happen, that is, network or location; expressed as node/line.

* **Who people, agent/work):** The framework focus that addresses who is in-

volved in doing things, that is, people or agents; expressed as agent/work.

* **When(time, event/cycle):** The framework focus that addresses when things happen, that is, time or events; expressed as event/cycle.

* **Why (motivation, end/means):** The framework focus that addresses why things are done, that is, motivation, rationale or objectives; expressed as end/means.

The Zachman framework has evolved over years and become a model for viewing and communicating enterprise information infrastructure. Although the origin of the Zachman Framework is rooted in formation system architecture (Zachman, 1987) the majority of recent works have been focused on enterprise architecture. The complexity of a national-wide information system presents a challenge for utilizing this framework.

NISAF Overview

The NISAF describes an architectural framework that can support the Department's business processes as they are redesigned to meet the requirements of recent legislative and regulatory changes as well as responding to the rapidly changing technology environment. Departmental architectures must be closely aligned to the most pressing and critical strategic and operational business needs of the individual organizations. The Department sets forth the policies, standards, and guidelines necessary to design, develop, deploy, and support these architectures within the Department's components.

The purposes of this framework were to provide

* A common understanding of the NIS information technology vision

* A unifying concept, common principles, common terminologies, and common standards for national library information systems

* A context for identifying and resolving policy, management, and strategic technical issues

* A context for strategic planning and budget formulation of NIS

* A template for the development of national information system architectures

The major elements of the NISAF are described briefly in the following sections. Building national information system requires taking an architectural approach used by architects and engineers in building physical systems. An architectural approach simply means that all systems and related applications implemented to support process-related activities follow a set of principles and a technological pattern that is consistent and structured in order to meet a set of functional requirements and desired outcomes.

The architecture is constructed by determining recurring patterns of underlying information processing functions in the organization and thereby reducing the complexity of a system. The patterns are incorporated into a structural model along with a set of specifications explaining the model components, their functions and interactions. An example of a recurring pattern would be the underlying processes and information used in a purchasing activity whether the items being purchased were books, vehicles, paper, computers, construction materials or student services. The patterns of the underlying information processes used for purchasing will be consistent with patterns required in accounting applications, Registrar applications, management applications, etc. One of the objectives of the architectural approach is to find the minimal number of recurring patterns and their interactions, describe them, write specifications for implementing them and incorporate them as reusable components in a structural model. In the structural model posed above, all user services might have a set underlying pattern for finding information, browsing information, selecting information for viewing, and viewing information.

Unlike the architecture of a bridge or building, an architecture for information is more of a process than a product. The architecture of an information system results in a set of electronic documentation that should act as a "living document" which is updated on a continuous basis as the organizational environment and the technology change.

The starting point for an architecture after a conceptual description is a basic philosophy and a related set of principles [Lawson, 1990]. The philosophy defined by a related set of principles provide an architectural framework for a system by articulating the objectives and quality characteristics that the architecture should follow. They are intended to communicate and guide the system design relative to all aspects of the information system, its services and processes. The quality characteristics stated in the philosophy determine the technological approaches taken in defining components of the architecture and how they must operate. The principles are meant to provide a basic set of patterns by which information system design decisions can be made.

Architectural Philosophy as a Set of Principles

The architecture must articulate a philosophy in the form of a set of principles to establish a set of basic patterns for designing and implementing systems. This set of principles is

based upon an assessment of information systems currently in use in the organization and the information system requirements presented by users as part of the analysis. Some principles relate to the mission, some to the goals and some to the objectives of the information system thereby producing two categories of principles; general strategic principles and more specific design oriented principles.

We will only focus on the general principles. Each principle must be defined in operational terms such that managers, designers, implementers, and users understand why a principle is included and exactly what it means. This is effectively done by using focus groups in an organization to help identify, develop and define the principles. The general principles will usually specify factors such as:

* Distributed computing environment.
* An open systems environment.
* Sharing of information.
* Adherence to standards.
* Use of modeling techniques.
* Making information visible.
* Utilizing consistent interfaces based on human factors.
* Distributed systems management.
* Client/server computing.
* Process oriented application program structure.
* Focus on end-user computing.

The following examples of architectural principles are intended to provide the basis for developing a framework for implementing a national information system. These principles should guide the design and decisions made relative to all aspects of the national information system and information related processes at the national level. They are meant to provide a set of patterns [Alexander, 1979; Johnson, 1992; Beck, 1994] by which national information system design decisions can be made.

General Architectural Principles:

These architectural principles apply to very high level strategic considerations of an information system and many are implemented at a policy level. These principles are analogous to determining the location, use, landscape, shape, size and general appearance of a building, how many rooms are required, building orientation, driveway and entrances, and environmental factors for a building architecture.

1. Regard information as a national asset

2. Treat information technology and infrastructure as a national asset:
3. Use functional capability and cost effectiveness as investment criteria:
4. Guarantee choice via an Open Systems Environment
5. Allow shared access to information via adherence to database standards:.
6. Base information processing on policies, standards, and models
7. Establish data ownership and stewardship policies:
8. Ensure data and document integrity via a data administration function:
9. Make data and documents visible:.
10. Provide flexibility via a client/server architecture:
11. Establish ease of use via an intuitive graphical user interface (GUI): .
12. Integrate applications and workflow via a process orientation:
13. Make seamless interconnections:
14. Reduce paper by capturing data one time, at its source:
15. Provide workflow assistance:
16. Ensure effective use of information technology via education and training:
17. Implement the national information system architecture using the following principles [Alexander, 1975, 1979; Love, 1991]:

I. **Organic order:** The planning and implementation of the information architecture will be guided by a process that allows the whole to emerge gradually from local implementations, guided by the proposed information system philosophy and structure.

II. **Participation:** All decisions about what will be built, and how it should behave will be in the hands of the users at various levels.

III. **Piecemeal growth:** The implementations undertaken in each budgetary period will be weighted overwhelmingly towards small projects since large scale development hinges on a view of the environment that is static and discontinuous. Piecemeal growth hinges on dynamic and continuous growth.

IV. **Patterns:** All design and implementation will be guided by a collection of communally adopted design principles, called information processing patterns, that will guide the design of everything. The patterns may be very large ones or very small and specific ones. Some patterns will deal with the behavior of computer interfaces, some with the distri-

bution of data, some with hardware configurations, some with network protocols, and others with database access methods.

V. **Diagnosis/Evaluation:** The well being of the architecture and the envisioned information system will be protected by an annual diagnosis/evaluation system which will explain, in detail, which information system activities are alive and which are dead, at any given moment in the history of the system. The feeling for work life will always outstrip the current patterns for processing information.

VI. **Coordination:** The slow emergence of organic order in the whole will be assured by a funding process that regulates the stream of individual projects put forth by users. The use of a standard template to fund projects, describe projects, describe patterns of information processing, perform diagnosis and estimate costs will aid in prioritizing projects.

The Conceptual Architectural Framework of the National Information System

The following sections describe the National Information System Architecture from the conceptual perspective focusing on the six views, the WHAT, the HOW, the WHERE, the WHO, the WHEN and the WHY, presented in Figure 1.

The What View: the data

A national information system is a data-centric system incorporating data in a wide variety of forms and formats and from a large number of sources. These are bibliographic data, full text documents, structured business and transaction data, digitized voice, images or motion video. The main source of these data forms is the depository system, the system which ensures that data and documents related to all aspects of Kuwait society are captured and stored in a common national depository accessible by various other information centers both locally and globally.

These data and documents are the central focus of the NIS that are required to fulfill the mission of the system and the set of users for which NIS exists. Data and documents are extremely complex entities as are the processes required to acquire and process them and the information services that depend on them.

There is an enormous cost associated with the creation and acquistion of the large volume of data and documents within the national information system. Management of these data storage and accessibility to all those authorized to access them. Therefore, a strong national information policy is required.

The data and documents component of the architecture is critical as it ensures that the technology will be applied and that the innovations implemented will provide information to support daily operations user services, technical services, planning, decision making, problem solving and budgeting. Additionally, it serves to improve the quality and the outcome of work performed.

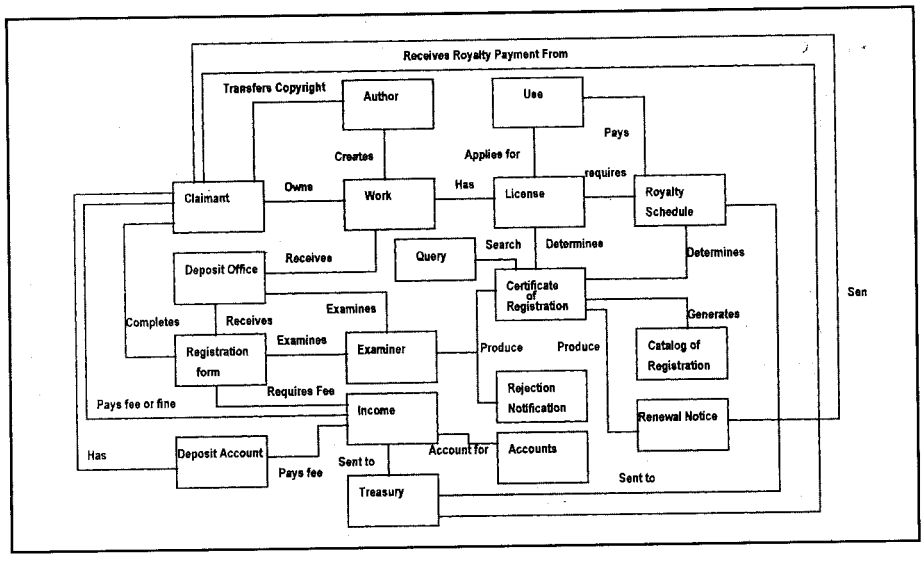
The How View: the function

The HOW view of identify he main function and core processes related to the NIS conceptual model. These functions are as follows:

1. Data and Document administration function

The data and document administration function is responsible for proposing and implementing policies and procedures related to all aspects of the data and document management activity. Primary among these responsibilities are identifying and defining data and document sources, creation of an enterprise-wide data and document model with associated schemas, maintaining enterprise-wide

Figure 2
A High Level Object Model for he Deposit and Copyright Process



data and document standards, analyzing documents and defining Document Type Definitions (DTD), standardizing data and document naming conventions, defining data models in conjunction with users, resolving data and document ownership issues, tracking the content of the national information system's databases and information repository, designing and implementing training and informational programs, evaluating and recommending data and document management software.

2. Collection Development Function

The collection development function is intended to provide inputs to the technical processing function with items for potential inclusion into the collection. This may occur either through the selection function or as a set of laws, policies and agreements with sources of information artifacts such as the deposit and copyright function, government agencies, exchange programs, gifts, mass purchase contracts and other such programs.

3. Deposit and Copyright Function

The deposit and copyright function is the main reason for the creation of National Library and as such this process represent the corner stone of the system and responsible for preserving and protection different works, literary, artistic, etc. Figure 2 represent an object model of this important process.

4. Technical Processing Services Function

This is the "behind the scenes" work that constitutes the processing and assembly line work to produce the raw material for user services. This system is quite large and has a number of subsystems necessary to achieve its objectives. Technical Services function is the core of the internal operations and must utilize information technology heavily in order to be efficient and effective in supporting User Services, Collection Development and Management functions.

5. User Services Function

These services represent the basic reasons that the National Library exists which is to provide service to its users which are predicated upon the mission, goals and objectives of the nation of Kuwait. The User Services utilizes nearly every other functions and its services and products in order to provide services for its users. These services are a combination of traditional services such as reference, referral, research, lending (circulation), CD-ROM database access, OPAC access and access to other information products.

6. National Programs Function

National Programs are designed to facilitate access to information and the national heritage for all citizens of Kuwait including blind and handicapped citizens. These programs are intended to communicate and create an awareness of Kuwait's past, present and future. Programs designed for children, Kuwait folk life and the blind and handicapped will have a high priority.

7. Management Services Function

These services provide administrative support for all the other Offices within the National Library without duplication of these services. These services cross over all other offices of the National Library and are essential for their proper functioning in an efficient and effective manner. The structure for this subsystem is as shown below. As can be seen, the use of information technology is central to not only providing services with the various offices but is also critical for providing management services as well.

8. Network Management Function

The function of network management is usually divided into 6 categories:

1. Network Operations
2. Problem Management
3. Performance Measurement and Tuning
4. Configuration Control
5. Change Management
6. Management Reporting

9. Security Administration Function

Security administration is one of the most critical components of the architecture. Administration is a human function that employs the security tools and services that implements the security policies of the organization. The security administration function is responsible for initiation and review of all policies related to security in the organization. This function is also responsible for providing all necessary events and information for a security audit.

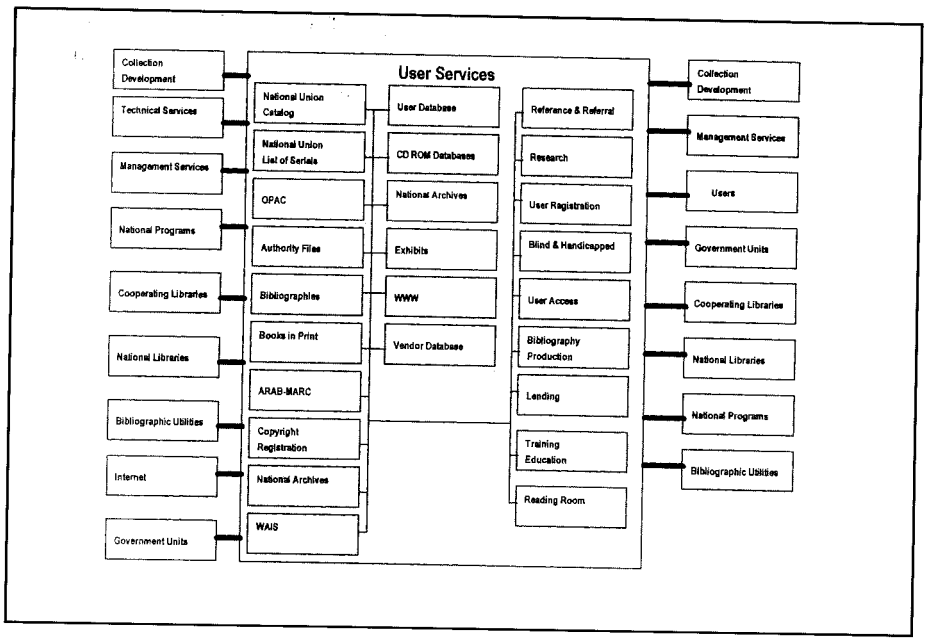
The Where View: the network

The WHERE view can be described in terms of :

1. Organizational Aspect

The national system will have an organizational structure with a responsibility model for guiding the implementation of the construction efforts. It also presents a set of activities necessary to position the organization so that all aspects of the architecture can be fully implemented in the final system.

Figure 3
User Services of the Conceptual View



2. Network Aspect

The glue that binds together the components in a distributed computing and information system environment is the network infrastructure. It is not only essential for applications to execute in a client server mode and to distribute data and applications but it is essential for managing all the components in a distributed information systems environment. A national information system will only be able to offer its services and function efficiently in a highly networked environment that includes not only the national government organizations but also the entire nation and to some extent the rest of the world. The use of telecommunication facilities provides a time and location independent capability that is needed in this age of information and distributed service capabilities. The major objective of network communications is to support applications that require access to distributed resources.

The Who View: the user

The national information system will provide a number of services and products to different classes of users in order to fulfill its cultural, scientific and social mission to the nation. There are two broad categories of users: end users and the professionals.

The categories of end users that might be expected, in decreasing order of importance, are:

1. Academic Researchers (Arts, Sciences, Humanities, etc.)
2. Professional (Physician, Engineer, Social Worker, Educator, etc.)
3. Government Researcher
4. University Student
5. Legal Researcher
6. Religious Researcher
7. Concerned Citizen
8. Common Reader
9. Pre-University Student
10. Juvenile (prereader to adolescence)

The categories of professionals from other information centers fall into the following six broad areas:

1. direct referral or service to end users
2. end user reference or research,
3. technical service assistance (bibliographic and authority controls),
4. technical reference or research,
5. specialized services (support for blind or handicapped patrons),
6. education and training.

Using these broad categories of users allows decisions to be made about end user services and products. The classification for user services and products shown in Figure 3 is broadly based on these categories of users. In many cases, these services are dependent upon the agreements made with other institutions and the development of standard technical approaches as outlined in previous sections. In Figure 3, User Services gets its inputs on the left and produces its outputs to users on the right. Everything in between is a product or process that must be supported by the technology platforms selected.

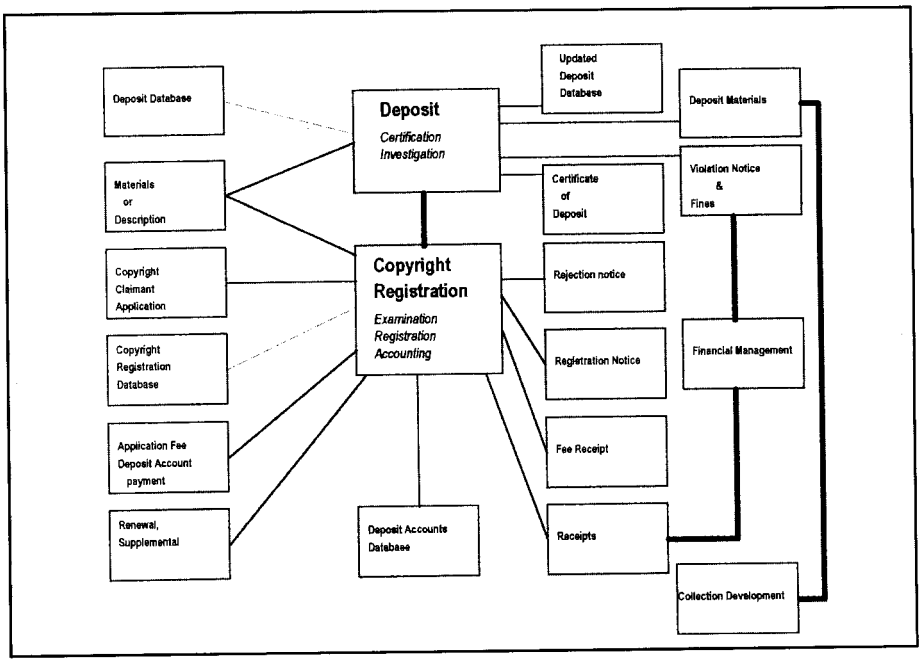
Security policies must also be established and documented both for the physical security of the building, equipment, collection and personnel but also logical security related to information access and privacy.

Some of security services that can be provide are[Pfleeger, 1989]:

1. Identification and Authentication
2. Access Control
3. Confidentiality/Privacy
2. Integrity
3. Access Control Lists (ACL's)
4. Encryption/Decryption Capabilities
5. Modification Detection and Message Authentication

6. Digital Signature

Figure 4
A High Level View of Copyright Registration Process



The When View: the event

A national information system must identify its core processes for each component in the architecture and how they are related. A process is defined by the inter-related outcomes that it produces in terms of services and products and the events that trigger the activities required to support the process. The flow through a process represents the data and documents that enter into and exit from the activities for a process. Each of the core processes has a set of sub-processes, which act as threads of inter-related activities. In some cases, data and information flow across processes so there are inter-process relationships as well as intra-process relationships. The fewer inter-process relationships, the better defined a process appears to be. The core processes represent the workflow of the national information system and the services provided by sub-systems to support its mission. This is analogous to the way a manufacturing plant or refinery must be architect so that the flow of raw materials are transported to the processing or assembly points in the right order, at the correct time, in the correct amounts, and at the appropriate levels of quality.

The main and the driving force of the NIS, as it was mentioned earlier is the depository process depicted in Figure 4.

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The Why View: the motivation.

The mission statement and the associated goals provide a direction, framework and guidelines for all other components of the architecture for the NIS. It is evident where these relate to agreements, collection development, management services, information technology and networks, standards, user services, education, technical services and bibliographic tools and education.

All national organizations in Kuwait that acquire, process, access or otherwise use data and information constitute the potential user base for the national information system. These organizations will be provided the opportunity to participate in formulating policy and procedures, determining management services, formulating contracts and agreements, implementing legal and regulatory requirements, and providing data, documents, and services to support the national system. To its users, the national information system will appear as a single set of applications and data repository automating the information processing activities that any user needs to perform relative to the mission of the national information system. All activities such as technical information services, user services and data and document services, will involve a familiar set of information processing tasks, each with a standard interface. The system will create the illusion that all data is stored and processed at the user's location regardless of where the data or application is actually stored or executed. The interface will look, feel and function the

same across all applications that comprise the national information system.

Summary

The mission and goals of a national information system for the State of Kuwait is to acquire, organize, make accessible, and preserve the national and cultural heritage of the country. A macro-level conceptual framework for the architecture of a complex and diversified nation-wide information system is described that was derived from Zachman Framework, a well know frame, and could be used as the base for the design and information requirements of NIS.

The processes associated with data and document services, technical services and user services along with the associated architectural principles are implemented in software, hardware and telecommunication facilities. The design of software and the selection of hardware and networking components can be guided by several views of these technological components as outlined below.

The large-scale technological components of an architecture could be presented in five categories as follows:

* The ***client/interface*** describes what is required at the user's desktop to provide access to the information processing functionality and improve productivity and work life. It includes software components as well as guidelines and standards for implementing a user interface to information and functionality.

* The ***application*** shows how common applications with their resultant high-level data flows must be integrated to support the core processes in the organization. It provides an evaluation of current applications from a process-oriented view. It also presents some expected benefits to be derived by acquiring and enhancing common application software.

* The ***data and document*** describes the need for making information widely available and what is required to make this possible. This view includes a basic architecture for making information accessible for different purposes. This view proposes a set of activities and technical components and describes how they can be organized to ensure awareness, identification, accessibility, authentication and authorization of access, and the efficient and effective processing of data and documents by users. It also includes a data and document administration function be created and charged with developing an inventory of data and document types and a data model. A high-level data model is required as a starting point for this activity.

* The issues of ownership, stewardship and security of data are also

covered with a set of guidelines for consideration.

* The ***system management*** makes recommendations for how management of a distributed system can be supported via hardware and software products. This includes managing desktop assets, servers, software distribution and installation, software licenses, networks, security, data, and hardware configurations.

* The ***platform*** presents recommendations for hardware and system software that adheres to standards and opens and distributed system products. It also suggests the use of standard protocols and a standard look and feel as a platform for desktop devices.

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الملخص

المنهج المعماري:
إطار لنظام المعلومات الوطني لدولة الكويت

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محمد دفتدار عبدالهادي
وزارة المالية بدولة الكويت

يُعد تجميع التراث الثقافي الوطني للكويت والحفاظ عليه أحد الأهداف الرئيسية لنظام المعلومات الوطني لدولة الكويت، ويتطلب نظام معقد ومتشعب مثل هذا النظام إطار مهاري مثل إطار (Zachman, 1987, 1997) الشائع الاستخدام في هيكله نظم المعلومات المؤسسية. وتناقش هذه الورقة النظرة إلى المفاهيم المعمارية لنظام المعلومات الوطني لبيان تلك المفاهيم للمصححين والمنفذين ومشغلي ومستخدمي النظم.

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