National Science Foundation's Digital Government Program

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1. Introduction

The purpose of this paper is to briefly discuss the Digital Government Program at the National Science Foundation (NSF) in the US, some sample projects supported by this program and draw some conclusion about how do such projects relate to the European Union. The paper also discusses a case study of an ongoing project at Rutgers University Center for Information management, Integration and Connectivity that is supported by NSF.

2. NSF Digital Government Program

2.1 Background

2.1.1 Objectives

The following are among the objectives of the US National Science Foundation digital Government program.

- Partnering leading-edge computer scientists with forward-thinking government agencies and the private sector

- Explore and develop new information technologies that will improve the way government serves the public.
- Funding for a broad array of research
- Funding can serve as the foundation for expanded studies under additional government funding.

2.1.2 Goal

- To build a research domain of problems that intersect traditional NSF Computer/Information Science research communities and experimental deployment needs of the Federal information service communities.

2.1.3 Research Support

NSF provides support for research projects that innovatively, effectively, and broadly address:

- Potential improvement of an agency,
- Interagency interactions,
- Intergovernmental operations and/or
- Government/citizen interaction

2.2 NSF Digital Government Funded Sample Projects

Below is a list of sample projects. For each of these projects, we then discuss specific aspects including, the objective, the research team, the research building blocks, and some observations as to how such project might be applicable to the European Union environment.

1. Digital Government: Transnational Digital Government (PI: Jose Fortes, Univ. of

Florida, Award Period: 2002- 2005, $ 1,500,000)

1 A Distributed Information Management Framework (REGNET) for Environmental Laws and Regulations(PI: Kincho Law , Stanford Univ., Award Period: 2000-2004, Amount: $ 1,000,000)

2 Digital Government: Geospatial Data Mining Techniques for a Multimedia Integrated Modeling System (PI: Hassan Karimi , Microelectronics Center of North Carolina, Award Period: 1999-2001, Amount: $ 39,943)

3 Database Middleware for Distributed Ontologies in State and Federal Family & Social Services(PI:Ahmed Elmagarmid, Athman Bouguettaya, Virginia Tech & Purdue Univ, Award Period: 2000-2005, Amount: $ 499,998)

2.2.1 Digital Government: Transnational Digital Government

- **Objective** :
  - The domain is drug interdiction, Under an arm of the Organization of American States (OAS) - the Inter-American Drug Abuse Control Commission.
  - Member states of OAS collect, share and analyze information in standard ways.
- **The Team**
  - The US research team: Organization of American States, North Carolina State Univ., CMU, Univ. of Colorado, Univ. of Florida**,** Univ. of Massachusetts
  - Researchers from universities in Belize, Mexico, and the Dominican Republic.
- **Research Building Blocks**
  - Spoken dialogue systems,
  - Data management and security for rule-based data sharing and filtering,

- Information retrieval and machine translation,
- Middleware to support these transnational information grids, and
- Network behavior modeling for acceptable quality of service.

- **Impact for EU**
  - Interoperability across multiple governments – data/information, language, policy

2.2.2 A Distributed Information Management Framework (REGNET) for Environmental Laws and Regulations

- **Objective**
  - The Regnet Project will develop a formal, practical infrastructure to enhance access to government regulations
  - The infrastructure includes distributed data repositories, to create tools to locate, merge, compare, and analyze the information.
- **Team**
  - Involvement of experts in law, computer science, and civil/environmental engineering.
- **Research Building Blocks**
  - Textual storage,
  - Semi-structured indexed storage,
  - Means to resolve semantic ambiguities,
  - Cross-referencing appropriate for automated access from relevant legal documents, and
  - On-line compliance checking of government regulations.
- **Impact for EU**

- Enhancing access to government regulations for use by citizens and entrepreneurs

2.2.3 Digital Government: Geospatial Data Mining Techniques for a Multimedia Integrated Modeling System

- **Objective:**
  - Model the transportation and ultimate effect of nutrients and chemicals.
- **Team**
  - Microelectronics Center of North Carolina
  - EPA would be the primary partner agency
  - US Geological Survey,
  - The Neuse River basin watershed in North Carolina
- **Research Building Blocks**
  - Geospatial data mining,
  - Searching,
  - Extraction techniques for integrated air, water and land environmental modeling activities in a distributed environment.
- **Impact for EU**
  - Exploring the implementation of Geospatial analysis and Geospatial data mining for management of resources such as watersheds and transportation networks

2.2.4 Database Middleware for Distributed Ontologies in State and Federal Family & Social Services

- **Objective**
  - A Web service management system for government Web services
  - An infrastructure for uniform, secure, and privacy preserving access to government Web services
  - Help case officers and needy citizens collect social and welfare benefits to which they are entitled
- **Team**
  - Indiana Family and Social Services Administration,
  - The Indiana Dept. of Workforce Development,
  - The US Dept. of Health and Human Services.
- **Research Building Blocks**
  - query infrastructure,
  - middleware for the web,
  - dynamic inter-ontology support
- **Impact for EU**
  - Secure access to web services in Government Public health systems
  - Web service management system for Multi- government web services

3. “E-Government: Human-Centered Systems for Business Services” Project

This is an ongoing project sponsored at Rutgers University CIMIC that is supported by NSF at $916,949 for the period 200 through 2004. The research work is conducted jointly with the State of New Jersey.

3.1 The Context

The Chief Information Officer (CIO) and the Chief Technology Officer (CTO) of the State of New Jersey had the vision of providing the citizens of the State with first-rate service delivered with a state-of-the-art technology in the most intuitive, user-friendly, and efficient manner. Specifically, their objectives include the following.

- Seamless delivery of on-line services:
    - ***Government-to-Citizen (G-C)***
    - ***Government-to-Business (G-B)***
    - ***Government-to-Government (G-G)***
    - ***Government-to-Employee (G-E)***

In addition, there were strong commitment from the State for e-government development and interest-from top level down. At the time, the State just started a centralized Office of e-Government within Office of Information Technology and the State was willing to commit enough resources to advance their objectives.

On the other hand, Rutgers CIMIC has the following objectives that are synergistic with the above-mentioned objectives of the CIT/CTO of the State of New Jersey.

- Works together hand in hand as one team with the OIT to help contribute to CIO/OIT vision
- Focuses on the research and long-term aspects of some of the issues
- Leverages its working relationship with relevant research communities around the globe.

- Develops a proof of concept and evaluation studies
- Explore means of transferring some aspects of the proof of concept to the State

Rutgers CIMIC and the State CIO/CTO came began their collaboration and applied to NSF to support the research aspect of the project with a matching fund from the State. The joint project on this initiative was eventually funded by NSF at the amount of $916,949 for the period 200 through 2004 and a research team was formed that was made up of the following members.

- Rutgers – CIMIC
- New Jersey State Government
- Columbia University
- University of Maryland Baltimore County (UMBC)
- City University of New York (CUNY)
- Small Business Development Center of New Jersey (SBDC)

3.2 Initial Focus–Business-Related Services For SMEs

Advances in information technologies have positioned electronic commerce (EC) at the forefront of business and commerce. In today's environment, it would not be feasible to expect an entrepreneurs to spend months interacting with the various state agencies to obtain relevant information regarding establishing its business.

Many federal and state agencies have been mandated to adopt EC technologies to help streamline and transform their core business processes. In response to these mandates, the New Jersey State government has recently established an initiative in EC whose goal is to provide an effective and efficient *single electronic interface* that fosters the establishment of new businesses and facilitates effective long-term interactive relationships with

businesses throughout the State. The initial focus was the Business Entrepreneurs who are considering establishing their business in New Jersey, specifically, Opening a new business, ongoing reporting, and closing a business.

The objective was to guide entrepreneurs through the process, specifically:

- Generate the exact tasks required for the specific business, and the sequence in which they need to be executed, and by which agency (workflow)
- Make the entire process transparent to the user
- Provide monitoring of the status
- Protect the security and privacy of user information

3.3 Overview

Our system is geared towards addressing the following pressing questions posed by any entrepreneur.

1. **What information is available for my business?** Many state agencies have established web sites that o.er information about the services they provided. The information comes in diverse forms: data gathered from forms, local maps, census data, unemployment data, track patterns, environmental data, real estate, the co-location of potential customers and the co-location of competing Or complimentary businesses, the availability of the labor pool, appropriate transportation corridors, the cost of renting, buying or building ones space, a showroom, storefront, etc., the state and local tax rates, zoning restrictions, government incentives, and many others, depending on the nature of business. Data gathered from forms submitted to these agencies are seldom exchanged. In our system, the scattered Information and services are aggregated and only a relevant subset are identified and tailored for each user’s personal and business requirements.

2. **Which agencies are relevant for my business registration process and in which order should I visit them?:** Registering a new business requires interacting with at least the following different state agencies: The Division of Taxation, Division of Unemployment and Disability Insurance, Division of Worker's Compensation, The Compensation Rating and Inspection Bureau, Division of Commercial Recording, and the local County Clerk's ones (for trademark and other local regulations). Some tasks (e.g. obtaining various permits) must often be obtained in a specific sequence, and knowledge of the appropriate sequence is frequently inexplicit and not shared among agencies.

3. **Why do I have to submit redundant information?:** Opening a new business requires submitting many forms and data associated with them to different agencies. Once agencies and their respective forms have been identified, they must be spelled out and faxed or mailed in. In most cases, such forms overlap considerably in terms of the basic level of data requested. Once this data is acquired by an agency, it is unlikely to be shared with other agencies.

4. **My business is established, now what other obligations do I have?:** Once a business is established, it must periodically interact with various government agencies for the purposes of paying taxes, withholding employee's income taxes, submitting compliance reports for occupational, safety and health, re-certification, and many others. The business community needs to be informed of updated information on policies and maintain relations with the State government with various tasks on their status.

3.4 Research Building blocks

The impact of this project is in three dimensions – (1) it advances the fundamental research in the areas of data interoperability, workflow management and multimedia object delivery and access, (2) it helps government agencies to provide an electronic front-end and associated human-centered systems to entice small and medium scale businesses by providing a smoother, customized process of establishing new business, (3) the resulting methodologies and systems developed will enable business persons, entrepreneurs and other citizens to interact with the state government in an effective fashion never previously possible. The research and development work undertaken is generalizable and therefore can serve as a reference model to be adopted by other agencies and services both in New Jersey and in other states.

3.4.1 Automatic Service Identification, Composition & Delivery

To guide entrepreneurs through the process of establishing their business, we propose to research and develop workflow systems that

(1) generate a customized workflow that is dynamic in nature, based on user parameters, requirements and constraints such as the type of business being initiated;

(2) automatically execute the different processes involved at appropriate agencies by authorized individuals, adhering to the business policies of those agencies; and

(3) visually report the progression of the workflow to the entrepreneurs. The workflow specification and monitoring module is responsible for generating customized workflows based on user parameters, and for

monitoring the progression of the workflow, whereas the workflow interface is responsible for visually depicting both. The customization is accomplished by selecting the appropriate set of workflows, the

- Automatic Generation of Customized inter-agency Workflow
- Ad-hoc/dynamic service composition for different individualized customer situations
- Identify required services
- in accordance to regulations
- user preferences/profile
- Glue them according to regulations and other constraints

Our Approach: Automatic Workflow Composition

- Capture workflow concepts embedded in Regulations
  - Services, conditions, ordering steps
- Using hierarchical knowledge structure (ontology = concepts + relations)
  - Automatically constructed from text documents
- Automatically generate a customized workflow
- Ontology
  - Provide a foundation of terms and mappings between equivalent terms used by different state agencies.
  - Build knowledge base

- Workflow System
  - Utilize Knowledge base for workflow generation
  - Execute workflow
  - Automatically determining necessary Steps and identifying forms customized for

each entrepreneur

- Decentralized workflow execution
- Flexible level of agency participation
- Decentralized Workflow Execution
- Integrate the different systems, while preserving existing online services and autonomous systems
    - Build on existing online services
    - Preserve the autonomy of each agency
    - Provide data sharing with Automatic submission of information to the relevant agency in the right order
    - Flexible level of agency participation
- Customize solutions to fit agency's service environment
- Monitoring the complete process

3.4.2 Universal Access Challenge

In general, users have various capabilities, e.g., Physical, Technical, Linguistic, and Domain expertise; various characteristics, e.g., Mobility, Different interests and preferences/profiles, uses different information appliances - hardware and software, e.g., PC, Work station, PDA, TV, Cell phone, Pager, as well as has Security credentials. At the same time, the objects available are of multimedia nature, e.g., maps, audio, video, images, text, electric, magnetic, thermal. These objects are Complex: multi-components with a variety of relationships among components -- relationships represent different types of constraints -- Constraints (specified by author of the object). In such an environment, there is a need to facilitate access to desired data of multimedia, composite

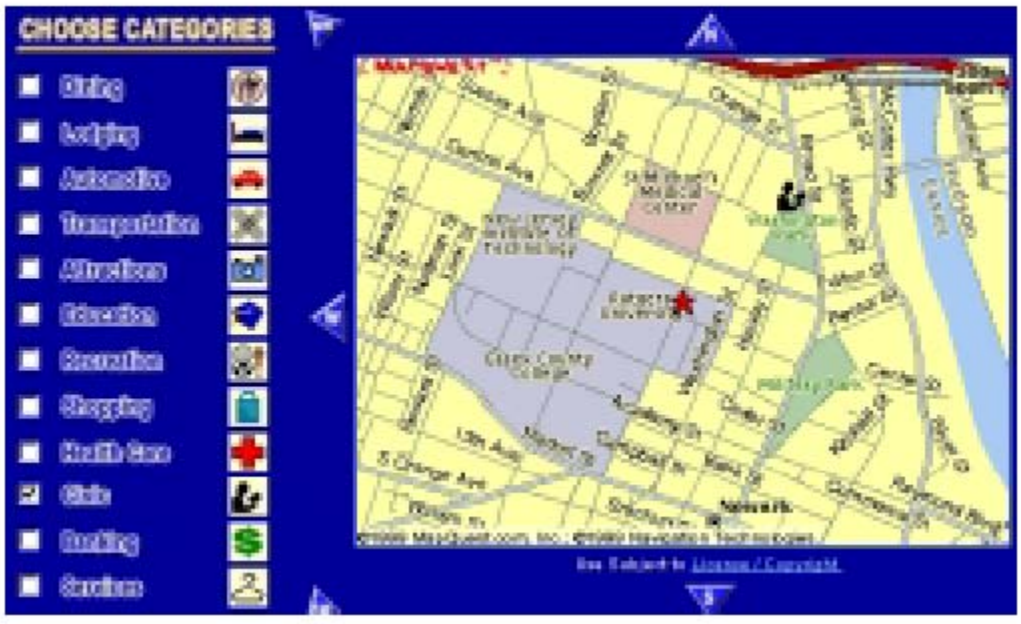
objects according to the various user's Capabilities and Characteristics, while at the same time satisfying the object's constraints (Synchronization, fidelity, and security) constraints. It is the objective of research work in the area of universal access is to cross these barriers and enhance communications across disciplines, languages, cultures -- "Make it available to anyone anywhere, at anytime."

The universal access component will support a web-based interface that facilitates the effective interaction between users and information sources. We have developed an approach that enables self-manifestation of composite multimedia objects based on user capabilities and preferences. Central to our methodology is the notion of *oblet*. Oblet is a small piece of software that installs itself on the client, examines the user and system profile of the client, determines the components and the order in which they must be played, retrieves the necessary object components, and then renders the object to the client accordingly. The objective of the oblet is to take over the responsibility of rendering the object from the server. Our intention was to minimize, as much as possible, the responsibilities of the server in order to avoid congestion and overloading at the server.

To accomplish this, we have first identified the various relationships and constraints among the various components of the multimedia object. These constraints are of three types: synchronization, fidelity and spatial constraints. Synchronization constraints specify the various temporal relationships that must be adhered to when playing the multimedia object. Fidelity constraints specify the capabilities of the client that are necessary for the object to be played with the specified quality. Spatial constraints

specify where each media component will be positioned on the user screen in relation to the other components. These constraints as well as the playback duration of each component are called the object plan. We have then developed a Petri net, called *multimedia object Petri net* (MOPN) to represent the object plan that lends itself to easy analysis. The object manifestation is comprised of object plan modification, object delivery and object rendition. We have developed algorithms to compute the latest time at which each object component must be requested by the client in order for the object to be played without any deadtime under network delays. This utilizes the deterministic and statistical network delay guarantees. We have implemented our universal access system in Java and we will apply this work in the *MyNJbusiness* system.

3.4.3 Web-based GIS Service:



Location information by means of a functional Geographic Information System (GIS) provides important assistance to business entrepreneurs in at least two fronts. First, an entrepreneur may be better prepared to make a sitting decision for his or her business if he/she has the appropriate geographic information for the area being considered. Information such as the location of currently established businesses, track movement statistics, boundaries of economic incentive zones, census statistics on household income, education, average size and age distribution of family units and the ethnic makeup of neighborhoods are all factors that may want to be considered. We have developed an interactive mapping technology that provides the ability to effectively deliver this information to the user via the WWW.

3.4.4 Automatic Verification of Business Policies

One of our objectives is to dynamically generate a customized workflow based on user parameters, requirements and constraints, and automatically execute the different processes involved at appropriate agencies by authorized individuals, adhering to the business policies of those agencies. In order to perform the verification process, we intend to employ the relational transducer developed by Yesha et al. Such a dynamic verification is essential since workflows are themselves dynamic in nature. A relational transducer maps a sequence of input relations into a sequence of output relations. While the relational transducer can verify if the policies themselves are static in nature. We intend to extend this to a negotiation scenario where both parties may relax their policies in order to optimize the business agreement.

3.5 System Evaluation

Our prototype system has undergone a number of evaluation phases as discussed below.

- Phase I - Pilot evaluation
    - Subjects: Volunteers from NJ SBDC Workshops
    - Instruments: On-line survey completed after first business is created on-line
- Phase II – Continuous Evaluation/Feedback
    - System Revision: Based on feedback from Phase I
    - Subjects: Anyone visiting the demo page
    - Instruments: On-line survey completed after first business is created on-line
- Phase III – Formal Controlled Experiments
    - System Revision: Same as Phase II
    - Subjects: MBA Entrepreneurship students from Rutgers and Baruch
    - Instruments:
        - Controlled laboratory experiment: subjects given a specific task (types of bus. to open)
        - Pre-task questionnaire to determine familiarity with opening a bus. and internet/web
        - Post-task questionnaire to gauge system effectiveness

3.6 Strategy for Collaboration with the State Agencies

Our strategy for collaborating with the various State agencies can be summarized as follows. This proved to be effective.

- Approach the right level of people in the hierarchy at the right time
    - Steering Committee: Blessing of the high level officials
        - Planning, directions and decision making
        - CIO, CTO, Director

- Focus working groups: from different agencies for technical and development discussions. Representatives from the following agencies were included, Office of Information Technology, division of Revenue, department of Commerce, department of Community Affairs, and department of Environmental Protection.

- Maintain a delicate balance between research and development
  - Respect division of labor: not stepping into each other's territory
    - Research team: research agenda and develop a prototype as a proof of research concept
    - The State: maintain their development efforts
      - Adopt features of prototype for existing systems
      - Expand and adjust for full-blown system
- Progress Presentations
  - The State:
    - Monthly business portal meeting among coalition group
    - Consolidating web pages and databases from different agencies
    - reducing data redundancy and enhancing data interoperability
  - Research Team:
    - Presentations of research results to the committees.
    - Prototype demos – feedback from the State.
    - Discussion on the technical findings and transport requirement issues.
- How we made them buy into our concepts.
  - Our system architecture is sensitive to:
    - Different computing and business process environment of each agency.

    - Agency specific technical and resource limitations.
    - Each agency culture and structure.
    - Dynamism among different agencies.
- Our model does not force to conform but considers the realities.
- Use existing systems and build upon them.
- Lend it to changes in the existing agencies.