

# How Does NSDI Development Fit into Pakistan's E-Government Programme?

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## Abstract

The notion of National Spatial Data Infrastructure (NSDI) and E-Government has grown about a decade ago, apparently, to address the challenge of quick supply of information, making use of Information and Communication Technology (ICT). The E-Government programme was advocated and initiated by politicians where as the need to have National Spatial Data Infrastructure (NSDI) was more emphasized, advocated and aimed by scientific and research communities rather than politicians. As, politicians govern over countries rather than scientists and researchers, therefore, E-Government received more projection and recognition by the governments giving significant consideration to Information Technology (IT) as compared to NSDI in countries like Pakistan.

Pakistan launched E-Government programme in 2005 with the aim to deliver public service information, efficiently, effectively and economically to the citizens. Pakistan's E-Government programme included GIS for Agriculture, Natural Resources & Urban Property of Pakistan, Mapping and Database of National Cartographic Data. The programme also included establishment of Land Records Management Information System. Apparently, none of these geospatial applications can be developed with single data set. Therefore, multiple data sets are required that are possessed by different organizations due to varying mandates for data collection. Hence, the need to have a cross organizational platform such as NSDI for exchanging, sharing and reusing spatial as well as non-spatial information is inevitable. Moreover, NSDIs are built on Internet technology, which provides an ideal distributed environment for widespread sharing, exchanging, integration and dissemination of spatial as well as non-spatial data. Therefore, it is good opportunity to make use of internet technology as access network provided by the E-Government programme of Pakistan for the development of NSDI in the country. Hence, "How does NSDI development fit into Pakistan's E-Government programme?" is a viable question that needs to be addressed, explored and researched which is the focus of this research paper.

**Keywords:** National Spatial Data Infrastructure, E-Government, Pakistan

## 1. INTRODUCTION

This is the era of digital information. That's why many countries around the world are developing digital information vigorously and implementing wired as well as wireless Service Delivery Platform (SDP), to ensure dissemination of the developed information timely to citizens via internet technology as confirms recently published report of the United Nations E-Government Survey for the year 2010, "...governments continue to focus on online and mobile dissemination of information (p.4). The survey has shown that users prefer localized and personalized services, attributes that usually call for interdepartmental cooperation (p.4) which is the heart of NSDI and E-government initiatives.

Pakistan is among those countries where development of digital information and its delivery is on the political agenda. The digital information is of two kinds i.e. Geographic Information (GI) and non-geographic information. Geographic

information (GI) is special because it refers in one way or another to a location relative to the earth. Other information can be linked to GI, for example, health care information, telecommunications, financial information, and traffic information. This specialty has not changed, Bastiaan van Loenen, Jaap Besemer and Jaap Zevenbergen (2009). Therefore governments are focusing on production and delivery of these both types of information. For that, huge investments are being made not only to generate digital information but also to develop and implement desktop as well as mobile information delivery systems coupled with institution building to deal with information development and its delivery. Hence, one can find a kind of duplication taking place in the name of E-Government programme as well as National Spatial Data Infrastructure (NSDI) development. Though, the ultimate goal of both initiatives is to provide the requestor with a high quality service in real time that would enable him to consume this service for technical, financial as well as administrative decision making for sustainable socio-economic development.

## **2. SPATIAL DATA INFRASTRUCTURE (SDI)**

The term Spatial Data Infrastructure (SDI) has been defined, redefined and still is being refined due to quickly changing global as well as local needs, priorities, downing economy and rapid developments in geospatial knowledge as well as technologies (Asmat, 2009). However, the development of Spatial Data Infrastructure (SDI) has been noted in grey literature to facilitate direct access to spatial and non spatial data, reducing organizational cost through sharing and exchanging information, capturing information once and reusing it, adding value to products and services through service chaining, improving decision making and having wider coverage of data distribution for sustainable development and economic growth. The concept has gained global recognition in the shortest time frame.

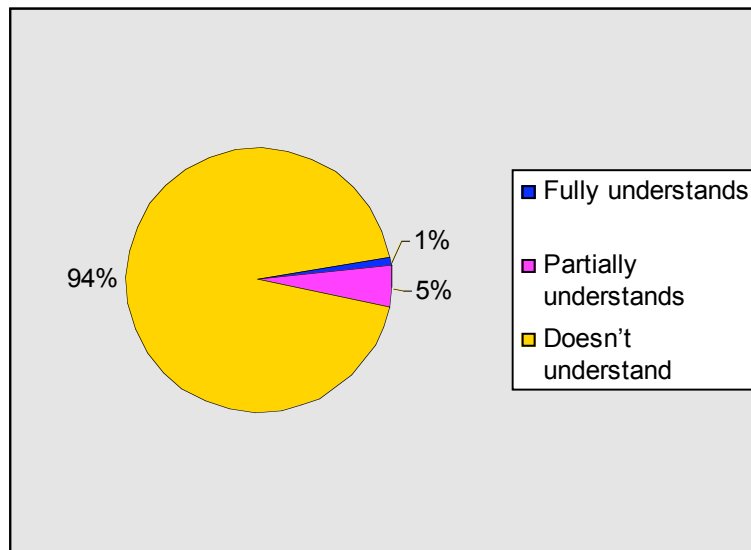
### **2.1 National Spatial Data Infrastructure (NSDI)**

National Spatial Data Infrastructure (NSDI) is developed at national or federal level to get rid of procedural delays in data delivery through one window operation for spatial data related activities. NSDI would cut down data production costs, improve spatial data access and use in a country as find Çetin Cömert and Halil Akinci (2004).

### **2.2 Pakistan's National Spatial Data Infrastructure (PNSDI)**

In Pakistan, lot of Geographic Information (GI) related activities are in progress that includes Land Management, Food and Agriculture, Environment Protection, Education, Public Health, Disaster Response such as flooding and earthquakes, as well as Homeland Security etc. There is no national coordinating body in the country that can institutionalize these fragmented and isolated organizational efforts in order to ensure, reduction of data duplication in terms of data collection, maintenance and storage, production of harmonized datasets, control and monitor national GI assets and their potential usage, setup one window operation for data sellers/buyers and save national money from being wasted in the era of down economy. One of the reasons of non-existence of national coordinating body like NSDI in Pakistan is that only a very small segment of society comprehends power of spatial data and information, as finds Bas Kok, Abbas Rajabifard and Ian Williamson (2008), "our capacity to understand the power of spatial information is remarkably small".

**Figure 1: Society's comprehension of spatial information**  
(Source: Bas Kok, Abbas Rajabifard and Ian Williamson, 2008)



From Figure 1, it is interpreted that, only 1% of people in any society really understand spatial information while 5% of people knowing little about spatial technologies. For 94% of people, spatial information is a mystery as argue Bas Kok, Abbas Rajabifard and Ian Williamson (2008). The same holds true for Pakistan as well. The importance and power of spatial data for good governance as well as socio-economic development was not realized for decades by policy makers in Pakistan. There had been a lack of political will to regard GI [spatial data] as national asset (Masser, 2005). Consequently, the establishing of appropriate policy, institutional and legal arrangements to deal with matters of spatial data was not given priority at higher levels. Therefore, Pakistan lacks in such institutions like National Spatial Data Infrastructure (NSDI). However, Government of Pakistan (GOP) has started listening to growing spatial data needs now to address the governance, geo-strategic and socio-economic problems of the country.

In Pakistan, spatial data is mostly being produced by public sector organizations that include Survey of Pakistan (SoP), Space and Upper Atmosphere Research Commission (SUPARCO), Pakistan Agricultural Research Council (PARC) and Census department etc. The fact is, spatial data producer organizations are not only the stakeholders of Pakistan's National Spatial Data Infrastructure (PNSDI) but it also includes NGOs, private sector, academic and research institutes, organizations like Ministry of Information Technology that enable data transportation as well as data user organizations. Table 1 displays major stakeholders and their role to support PNSDI.

**Table 1: List of major stakeholder and their perceived role to PNSDI**  
**A= Producer B= Supplier C= User**

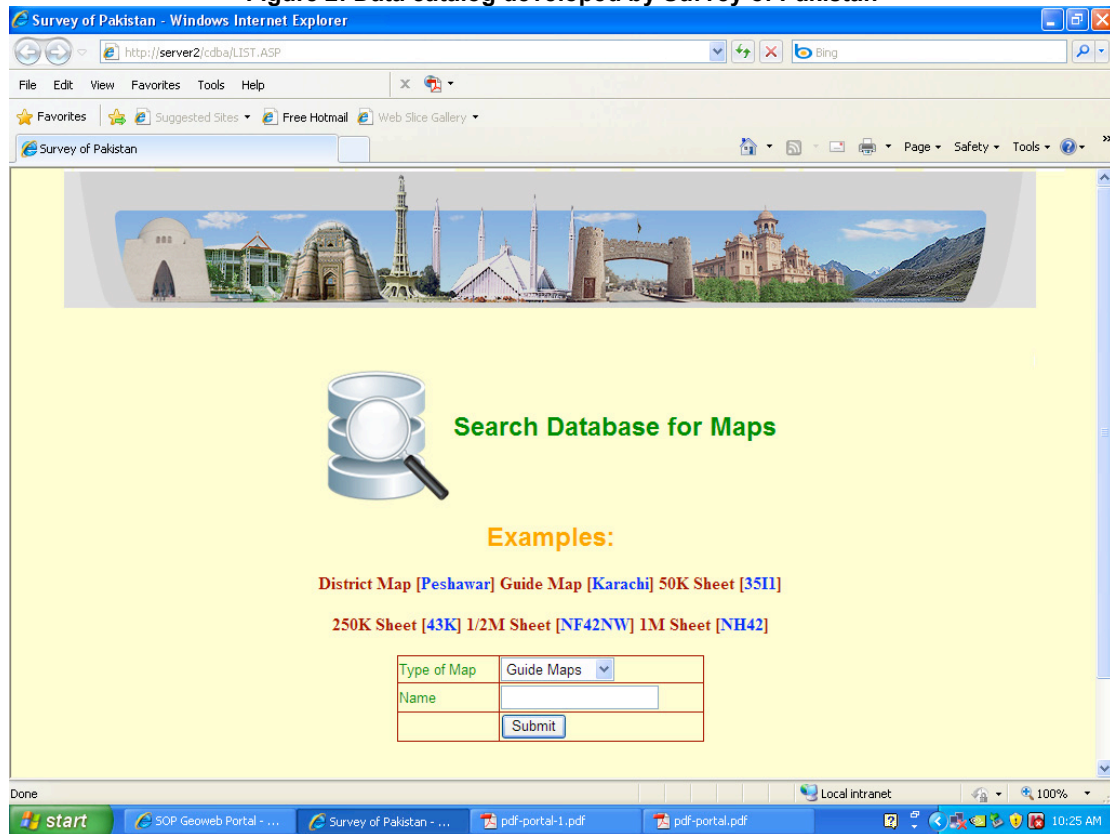
Sl. No.	Stakeholder	Category	Datasets Produced/Supplied/Used
1	Survey of Pakistan (SoP)	A,B,C	Topographical maps, Geodetic control
2	Geological Survey of Pakistan (GSP)	A,B,C	Geological Map
3	Ministry of Environment (MoE)	A,B	Fauna and Flora, vegetation
4	Ministry of Health	A,B,C	Health facilities
5	Space and Upper Atmosphere Research Commission (SUPARCO)	A,B,C	Satellite images, remote sensing data
6	Soil Survey of Pakistan (SSP)	A,B,C	Land use and soil map
7	Ministry of Water and Power	A,B,C	Water bodies, wetland, Ground water information
8	National Metrological Center	A,B,C	Weather information
9	Census department	A,B,C	Census information
10	Forest Department	A,B,C	vegetation
11	National Highway Department	A,B,C	Transportation network
12	Ministry of Tourism and Culture	A,B,C	Tourism & Cultural
13	Private Organizations	A,B,C	Large scale data
14	NGOs	A,C	Socio economic data
15	Ministry of Lands	A,B,C	Land use and Cadastral
16	Municipalities	B,C	Address, Building, utilities
17	Academic and Research institutes	C	Usage of all kinds of spatial as well as non spatial data
18	Ministry of Railways	C	Usage of all kinds of spatial as well as non spatial data
19	Ministry of Information Technology	C	Usage of all kinds of spatial as well as non spatial data
20	Pakistan Agricultural Research Council (PARC)	A,B,C	Land use and land cover data

From Table 1, it is understood that out of 20 listed organizations, 16 organizations that make up 80% of the total are engaged in data production activities. Therefore, there is tendency of duplication of efforts in producing and maintaining the same datasets that may already be available in some other organization. However, it is a unique opportunity for GOP to bring all these stakeholders under the umbrella of PNSDI to minimize wastage of national money that is indeed the demand of the current financial crisis of the country.

The results of a survey carried out in September 2007 in Pakistan (Asmat, 2008) show that Survey of Pakistan (SoP) is the richest organization in Pakistan possessing adequate human, technical and data resources to host Pakistan's NSDI

(PNSDI). SoP being in-charge of the official geographic information and mapping of the country is in the process of floating NSDI proposal. SoP has envisioned NSDI and therefore designed, developed and implemented geoportal consisting of data catalog as well (Figure 2) which is currently available on Local Area Network (LAN) and is believed to be available on the Internet after initiation of NSDI implementation.

**Figure 2: Data catalog developed by Survey of Pakistan**



Recent research as well as surveys conducted by international organizations such as GSDI (<http://www.spatial.maine.edu/~onsrud/gsdI/Pakistan.html>), European Union ([http://www.epsiplatform.eu/media/files/ppp4sdi\\_report\\_part1\\_v1\\_1\\_final](http://www.epsiplatform.eu/media/files/ppp4sdi_report_part1_v1_1_final)) as well as SDI-Asia and Pacific ([http://219.238.166.217/pcgiap/tech\\_paprs/SDIAPv5n6.pdf](http://219.238.166.217/pcgiap/tech_paprs/SDIAPv5n6.pdf)) have acknowledged that SoP being the National Surveying and Mapping Organization of Pakistan has potential as well as expertise to lead NSDI development in Pakistan as is happening in many countries that National Mapping Organizations (NMOs) are leading NSDI developments (Onsurd, 1998).

### 3. PAKISTAN'S E-GOVERNMENT PROGRAMME

During the last five years many western programmes and ideas have been adopted in Pakistan including Electronic Government (E-Government) program. The Government of Pakistan (GOP) announced its E-Government programme in 2005. A dedicated organization named Electronic Government Directorate (EGD) was established as coordinating body under the administrative control of Ministry of Information Technology (MIT). Though a number of E-Government definitions exist in literature however, it is important to know how E-Government was conceptualized in Pakistan. According to Pakistan's E-Government strategy and Plan, "E-Government is defined as the usage of Information and Communication Technologies (ICT) to support processes within the government as well as for the delivery of services to its consumers, including other organizations, citizens as well as businesses" (p.7).

The goals set for the programme were:

- Increase efficiency and effectiveness of the government
- Increase transparency and accountability in decision making
- Enhance delivery of public services to citizens efficiently and cost effectively

GOP planned implementation of its E-Government programme in following four phases (p.8). These phases match to Baum, C., & Maio, A.D. (2000) presented model.

**Informational:** This is the first phase and includes the provision of information alone. The quality, usability and currency of the content determine the value of this phase of E-Government. This is the least complex of all the phases.

**Interactive:** In this phase, E-Government provides some degree of online interaction. For instance, citizens can enter complaints or job applications online. This phase does not include secure transactions such as financial or other transactions that require a high degree of authorization and audit.

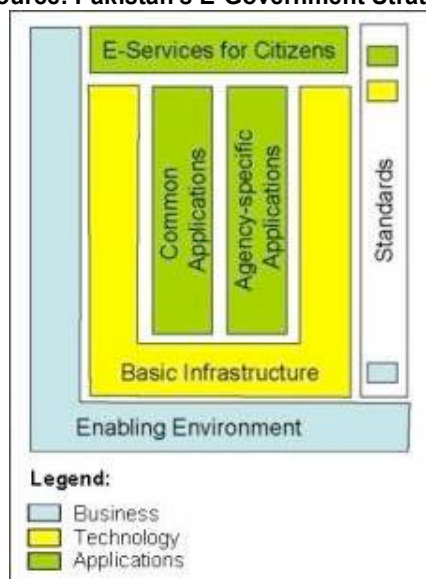
**Transactional:** Provides secure transactions with high level of authorization. Citizens can now apply online for passports, NICs and make payments online. This requires a high degree of security and basic infrastructure allowing for secure transactions.

**Collaborative:** In this phase citizens and businesses collaborate with the government on processes, projects, etc. This is especially important for businesses working together with the government on projects, for public-private partnerships, NGOs, citizen forums, etc. This phase requires a collaboration infrastructure, which brings together suppliers, consumers and the government in a network with the object of increasing value creation.

### 3.1 Framework of Pakistan's E-Government

The backbone of the E-Government framework envisioned by GOP was the delivery of services termed as E-Services to citizens via the Internet as illustrated in Figure 3.

**Figure 3: Pakistan's E-Government Framework**  
(Source: Pakistan's E-Government Strategy)



After critical study of Pakistan's E-Government strategy as well as framework, it reveals that the strategy adopted and being implemented by GOP is an implicit function of variables including policy advocacy, organizational development, capacity building and linkage between state and non-state actors. The perceived variables, indicators and their measured values are summarized as Table 2.

**Table 2: E-Government 's variables, indicators and their measured values**

Perceived Components of E-Government	Variables	Indicator	Measured Value
Policy	Policy advocacy	E-Government strategy document	High
Institutionalization	Organizational development	Established of a dedicated organization i.e. Electronic Government Directorate (EGD) to coordinate implementation efforts.	High
Training, Research and Development	Capacity building	Training, Research and Development opportunities from national and international experts.	Medium
Partnerships	Linkage between state and non-state actors	Development of Public Private Partnership (PPP) framework and PPP projects.	High

From Table 2, it can be concluded that E-Government has received well recognition by GOP which is unfortunately missing in Pakistan's National Spatial Data Infrastructure (PNSDI) case although a number of GIS and Remote Sensing (RS) related projects are part of country's E-Government programme as presented in next section.

### 3.2 GIS and IT Projects in Pakistan's E-Government Programme

A number of GIS and IT projects were planned to be included in Pakistan's E-Government programme. Some of which have been implemented, others are being implemented and rest of the projects would be taken up later. Table 3 summarizes these projects.

**Table3: GIS and IT Projects in Pakistan's E-Government Programme**

Project Name	Brief Description	Status
Economic Development mapping in 5 districts of Pakistan	The project is aimed at developing GIS-based economic development map of Pakistan, Decision Support System for better and effective planning and uniform distribution of development resources. (Source: <a href="http://www.e-government.gov.pk/">http://www.e-government.gov.pk/</a> )	Under Development
E-Services at Ministry of Food and Agriculture	This project includes development of Food, Agriculture & Livestock Information Repository (FALIR) system. In addition latest state of the art techniques like Remote Sensing and GIS are being used to develop crop forecasting models. (Source: <a href="http://www.e-government.gov.pk/">http://www.e-government.gov.pk/</a> )	Under Development

Land Revenue Records Management System	The aim of this project is to computerize the land revenue records so that all information is available and easily accessible as a single electronic database. (Source: <a href="http://www.e-government.gov.pk/">http://www.e-government.gov.pk/</a> )	Under Development
GIS for Agriculture, Natural Resources & Urban Property of Pakistan	It aims at provision of web enabled access to all citizens and foreign investors. Source: <a href="http://www.pak.gov.pk/e_government.aspx">http://www.pak.gov.pk/e_government.aspx</a>	Not yet taken up
Mapping & database of national cartographic data	It aims at provision of web enabled access to all citizens and foreign investors <a href="http://www.pak.gov.pk/e_government.aspx">http://www.pak.gov.pk/e_government.aspx</a>	Not yet taken up
Web Sites for 34 Ministries/Divisions	The main purpose of this project is to facilitate quick information delivery <a href="http://www.pak.gov.pk/e_government.aspx">http://www.pak.gov.pk/e_government.aspx</a>	Under Development
Process Mapping for improving efficiency of Ministry of Science & Technology	Its purpose is to do Business Process Re-engineering so that organizations could be aligned with E-Service vision of GOP. (Source: <a href="http://www.e-government.gov.pk/">http://www.e-government.gov.pk/</a> )	Implemented
Installation of LAN and implementation of Mail Tracking and Internal E-mail System at 07 Federal Government Divisions.	The objective of the project is to provide the basic IT Infrastructure for smooth communication and information exchange. (Source: <a href="http://www.e-government.gov.pk/">http://www.e-government.gov.pk/</a> )	Implemented
Federal Government Data Centre and Intranet (FGDC&I)	The project aims to establish interconnectivity of Federal Government entities with central Data Centre using secure / dedicated Metropolitan Area Network and establish a secure Data Centre for the provision of E-Services to these entities. (Source: <a href="http://www.e-government.gov.pk/">http://www.e-government.gov.pk/</a> )	Under Development
IT Security Audit of E-Government Projects	No description available. (Source: <a href="http://www.e-government.gov.pk/">http://www.e-government.gov.pk/</a> )	Not yet taken up
Prime Minister's Special Initiative for Paperless Governance for Federal Hospitals.	No description available. (Source: <a href="http://www.e-government.gov.pk/">http://www.e-government.gov.pk/</a> )	Not yet taken up

These projects are being implemented through Public-Private Partnership as the government alone does not possess required financial, expert human and technical resources (Pakistan E-Government Strategy). It is healthy sign to note that spatial information related projects are included in Pakistan's E-Government programme but the dilemma is, sharing, exchange and dissemination of spatial information via E-Government's portal of the country has not be considered, yet. Consequently, duplication of efforts in data collection, maintenance and storage is on the rise.

#### 4. BETWEEN VISIONS AND REALITIES: E- GOVERNMENT AND NSDI

The evolution of E-Government and NSDI is on the move in developed as well as developing countries. The concept of both initiatives is still not well grounded in practices. Simply said, both concepts are in their infancy as finds Donald Norris

(2008) as well as de Man (2007). Therefore, it is difficult to draw a discrete line between E-Government and NSDI where as existing fuzzy boundary between both initiatives may disappear with the passage of time when the era and concept of convergence get nourished and matured. In the meanwhile, governments continue development and dissemination of information without bothering about spatial and non-spatial information. One of such example is Pakistan's E-Government programme that included GIS for Agriculture, Natural Resources and Urban Property of Pakistan, Mapping & Database of National Cartographic data, land record information that added spatial dimension to the framework of E-Government. These activities are seen as "SDI-supporting initiatives", (Masser, 2005). It seems essential to explore components of Pakistan's E-Government framework and their supportive role in SDI implementation. The components and their perceived value for SDI implementation are shown in Table 4.

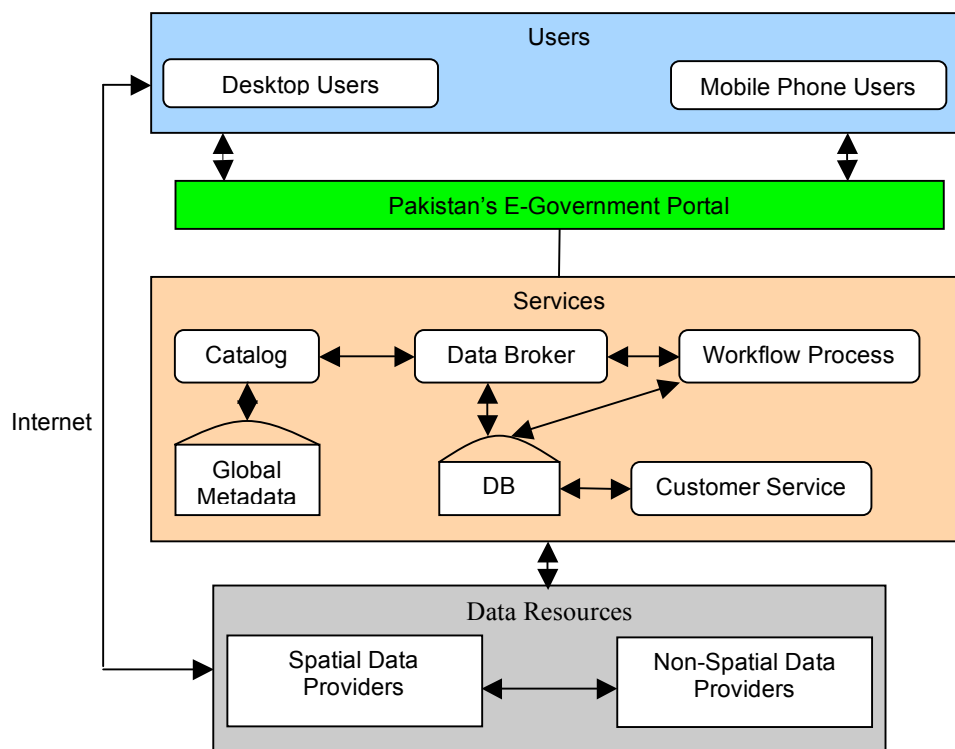
**Table 4: Components of Pakistan's E-Government framework and their value for NSDI**  
(Source: Asmat, 2008)

<b>Component</b>	<b>Value for NSDI</b>
E-Services	"SDI goals are changing from data access to service delivery...."Williamson (2004).
Basic Infrastructure	SDI is not implemented on a virgin and barren ground. The basic infrastructure such as hardware, software as well as information and communication technology (ICT) should be present on ground to support SDI implementation efforts. Every entity in infrastructure is important in itself for SDI. For example, ICT "facilitates access to relevant data sources and spatial information services by anyone, anywhere" (Cromptvoets et.al. 2004, p.8). Therefore, basic infrastructure that includes PCs, Intra-Ministry network, office automation software, intra-ministerial communication (Pakistan's E-Government Strategy, p. 5) would pave the path to SDI implementation.
Common Applications	SDI is not only meant for GIS, remote sensing and spatial analysis but an ordinary citizen should also be able to benefit from it such as to find the shortest route between places of his/her interest. Such common applications would help to deliver SDI benefits to the gross root level and masses would eagerly contribute in SDI implementation.
Agency Specific Applications	E-Government's GIS programmes are agency specific according to website ( <a href="http://www.pak.gov.pk/e_government.aspx">http://www.pak.gov.pk/e_government.aspx</a> ). Therefore, organizations mandated to carry out these programs would merely cooperate, coordinate and put their resources together in order to facilitate SDI implementation in order to "..... make geographic data broadly available, accessible and shareable for a multiplicity of users from different <b>applications</b> " (Morales, 2004)

Standards	Commonly accepted and implemented standards by all stakeholders play a vital role in SDI implementation. Standards help to overcome heterogeneity and make data sets as well as applications interoperable/shareable though developed by different organizations. Working within a common framework of standards ..... makes it possible to maximise the impact of the total available resources for SDI creation (GSDI Cookbook, Version 2.0, p.7). Also, "...standards will increase the value of ... data by facilitating data sharing through time and space (GSDI Cookbook, Version 2.0, p.24).
Enabling Environment	Enabling environment includes policies, stake holder's participation especially from private and business avenues and political support etc. To formulate policies conducive to data sharing, GOP's E-Government strategy envisions, "Necessary changes in Legislation, Rules and Regulations need to be identified and made (p.5).

From facts and figures presented above, it is concluded that NSDI development fit well into Pakistan's E-Government programme. NSDI and E-Government both are complement to each other as argue Masser (2005), Walter T. de Vries (2007), Bas Kok, Abbas Rajabifard and Ian Williamson (2008) as well as Asmat (2008). Moreover, to minimize redundancy of information and information systems, development approach needs to be shifted towards dissemination of integrated information services as illustrated in Figure 4.

**Figure 4: High Level Architecture of Infrastructure for dissemination of Integrated Services**



## **5. CONCLUSIONS AND FUTURE WORK**

The evolution of E-Government and NSDI is on the move in developed as well as developing countries. There is no discrete boundary between E-Government and NSDI. The ultimate goal of both initiatives is quick delivery of public services.

Indeed, the E-Government programme of Pakistan represents a paradigm shift in the way that the federal and local governments go about online service delivery and access to public information as well as data. But much has to be considered and incorporated in Pakistan's E-Government portal yet, such as spatial information that is being developed as E-Government projects but is missing in the portal right now.

Pakistan government is committed to go ahead to alter current scenario of spatial information as well as data development and its usage for national planning and sustainable development. Survey of Pakistan (SoP) has potential to play a pivotal role in any such initiative.

This study also reveals that some progress has been made in addressing the disconnection between NSDI and E-Government initiative, but there is still a lot of room for research in this domain.

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## **REFERENCES**

### **Articles in journals**

Crompvoets, J. et al. (2004): Assessing the worldwide developments of national spatial data clearinghouses. *Int. J. Geographical Information Science*. Vol.18, No. 7

### **Reports**

Baum, C., & Maio, A.D. (2000). Gartner's four phases of e-government model. Gartner Group.

United Nations E-Government Survey for the year 2010

Pakistan E-Government Strategy and Plan

[http://202.83.164.29/egdsite04/downloads/E-Government%20Strategy%20and%205-Year%20Plan%20\(19\[1\].06.2005\).pdf](http://202.83.164.29/egdsite04/downloads/E-Government%20Strategy%20and%205-Year%20Plan%20(19[1].06.2005).pdf)

[http://www.pak.gov.pk/e\\_government.aspx](http://www.pak.gov.pk/e_government.aspx)

### **Web-based articles**

Asmat Ali (2008). Is E-Government an SDI Implementation Strategy? Available at:  
[http://www.directionsmag.com/article.php?article\\_id=2922](http://www.directionsmag.com/article.php?article_id=2922)

### **Proceedings**

Asmat Ali (2009). Spatial Data Infrastructure for Land Administration in Pakistan.  
Proceedings of 7th FIG Regional Conference Spatial Data Serving People:  
Land Governance and the Environment – Building the Capacity Hanoi,  
Vietnam, 19-22 October 2009. Available at:

[http://www.fig.net/pub/vietnam/papers/ts01d/ts01d\\_ali\\_3571.pdf](http://www.fig.net/pub/vietnam/papers/ts01d/ts01d_ali_3571.pdf)  
[http://www.fig.net/pub/fig2010/papers/ts04b/ts04b\\_ali\\_4523.pdf](http://www.fig.net/pub/fig2010/papers/ts04b/ts04b_ali_4523.pdf)

Bastiaan van Loenen, Jaap Besemer and Jaap Zevenbergen (2009). Spatial Data Infrastructure Convergence. Proceedings of GSDI-11 conference, Rotterdam, The Netherlands.

Bas Kok, Abbas Rajabifard and Ian Williamson (2008). Spatial Enablement of Government and NSDI-policy implications. Proceedings of GSDI-10 conference, St. Augustine, Trinidad February 25-29, 2008

Çetin Cömert and Halil Akinci (2004). WEB Services, NSDI and E-government.  
Proceedings of FIG Working Week, 2004 Athens, Greece.

de Man, W. H. E. (2007). The multi-faceted nature of SDIs and their assessment – dealing with dilemmas. Presented at workshop Multi-view framework to assess national spatial data infrastructures, Wageningen University, 23-25 May 2007, Wageningen, The Netherlands.

de Vries, W. T. (2007). eGov and SDI : the common grounds and missing links. Proceedings of the 8th annual international conference on digital government research : bridging disciplines and domains, 20-23 May 2007, Philadelphia. Digital Government Research Center, 2007. ISBN:1-59593-599-1 (ACM International Conference Proceeding Series ; Vol. 228 ) pp. 270-271.

GSDI (2004): The SDI Cookbook Developing spatial data infrastructures: Version 2.0, 2004.

### **Books**

Donald Norris (2008). E-Government Research: Policy and Management

Ian Williamson, Abbas Rajabifard and Mary-Ellen F. Feeney (2004). Developing Spatial Data Infrastructure From concept to reality

Masser, I. (2005). GIS worlds : creating spatial data infrastructures. Redlands, ESRI.

Morales Guarin. (2004): Model - driven design of geo - information services. ITC Dissertation;110. Enschede, ITC

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