NewEnergy-GIS

ESTABLISHMENT OF 'NATIONAL GIS' UNDER INDIAN NATIONAL GIS ORGANISATION (INGO)

Defence GIS

SUBMITTED TO PLANNING COMMISSION

Private Sector GIS Applications

Roads Monitoring service

A NEW INFORMATION REGIME

THROUGH AN INDIAN NATIONAL GIS ORGANISATION

Census-GIS

Defence GIS

National GIS Portal

Steel-GIS

National GIS Policy

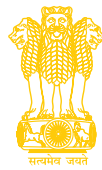Power-GIS

GOVERNMENT OF INDIA

MINISTRY OF EARTH SCIENCES

NATIONAL GIS INTERIM CORE GROUP

OCTOBER, 2011

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VISION

A NEW INFORMATION REGIME SUPPORTING

GOOD GOVERNANCE, SUSTAINABLE
DEVELOPMENT AND CITIZEN
EMPOWERMENT

THROUGH
AN INDIAN NATIONAL GIS ORGANISATION

OFFERING

GIS DECISION SUPPORT SERVICES FOR
GOVERNANCE, PRIVATE ENTERPRISE AND
CITIZENS

AND MAINTAINING
A NATION-WIDE, STANDARDISED,
SEAMLESS AND MOST-CURRENT GIS ASSET
FOR THE NATION

PREFACE

The most effective means of depicting events or phenomena over space and time is through spatial representation or a map. A Map explains relationship between different objects or processes. At the beginning of our civilization, information was represented as an artistic depiction. Today, with the advent of remote sensing, Global positioning system, organization of databases around Geographic Information System as well as advances in computing and communication technologies and digital cartography has revolutionized the map making.

India is growing rapidly and will continue to do so in coming years. We will need robust information and decision support systems to aid decision making process for planning and implementation of various developmental programs. Geographical Information Systems or GIS will be mainstay around which such information and decision support systems can be built. In view of this, the Planning Commission constituted the National GIS Interim Core Group (ICG) to formulate the vision, define programme details and broad implementation strategy for National GIS.

The ICG looked at the status of use of GIS in the country. We have several examples of use of GIS in managing disasters, natural resources and environment. Many programs and institutions such as National Resources Information System (NRIS) and National Natural Resources Management System (NNRMS) of the Indian Space Research Organization, National Spatial Data Infrastructure (NSDI) and National Resources Data Management System (NRDMS) of Department of Science and Technology, National Informatics Centre (NIC), to name few, have been implemented and provided vital inputs. The tsunami warning system has been built around GIS and is capable of providing information about travel time and run up heights at 1600 locations along the Indian Ocean within minutes. However, the use of GIS in many vital sectors such as agriculture, health, education, rural and urban development, infrastructure, etc can further be improved. We are yet to utilize the full potential of GIS technology - especially in governance, planning and decision support.

The ICG had number of consultations with various central and state governments, industries, academia and non-governmental organizations – thus expanding widely the opportunity to many professionals to participate in the visioning exercise. The final round of consultation was held in the National Workshop on September 14, 2011. In fact, over the series of consultations, almost 150+ experts have contributed and helped the ICG in this activity.

The ICG, over 6 meetings, also deliberated extensively to develop the concept of National GIS and the Indian National GIS Organisation (INGO). The ICG considered each and every input/recommendation very carefully and addressed them in most appropriate manner for the vision activity. ICG has obtained about 200+ inputs and suggestions – many of which have found way into the vision and programme document – thereby making the vision document as inclusive as possible.

National GIS is mainly a GIS-based Decision Support initiative on a well-founded GISReady data that is maintained and seamlessly available for the whole nation. It is expected that NGIS will benefit all, including government, industries, academia and private citizen. Government will be a great beneficiary as it would access a most modern tool that provides instant and updated GIS data and applications that will aid monitoring and implementation of programs. The process of establishment and subsequent operationalisation would provide considerable opportunities for private sector to contribute and be a part of this national endeavor. National GIS would also give a boost to education and research in GIS. To that extent, it will be a national capability building that will make India a fore-front nation in usage of GIS for nation-development and also in knowledge of GIS technology that would be important in the geo-political arena.

The ICG feels that the vision and programme definition exercise has been quite fruitful and has resulted in focusing a unique and innovation national capability of GIS and is of firm opinion that India is now ready and prepared to implement National GIS for development and governance.

With the submission of this report to Planning Commission, ICG has completed its main task. I would like to thank all my colleagues in ICG for their contributions in preparing the vision for the National GIS.

(Shailesh R Nayak)
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October 10, 2011

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EXECUTIVE SUMMARY

India is on a path of progress and growth. In the 12th Plan, focus is on agriculture; manufacturing; infrastructure, rural connectivity, health and education services and addressing special challenges for vulnerable/deprived areas. Looking even ahead, it is possible that Indian GDP would approach $9-10 trillion by 2025 powered largely by domestic demand and the transformation to a highly industrialized and technologically advanced economy.

With such a level of economy, developmental activities in India will demand a new paradigm and Governance regimes will need considerable change – moving from the traditional allocation systems to determining equitable systems. This would require a scientific mapping of the needs/aspirations/ desires and limitations of the beneficiaries and society, especially the most disadvantaged; transparent systems of inclusivity of citizen participation and entitlements; guaranteed development/service delivery with high-level of accountability of governance systems and a very effective (feed-back) and responsive redressal system.

India will require a vastly different information regime to arm itself for meeting the above challenges of a trillion-level of economy – powered by very efficient national information systems that will have to be the foundation for the governing and the governed – bringing the assessment of development needs, bridging disparity and gaps, bringing equity, transparency, inclusivity and citizen participation.

One such area is Geographical Information Systems – a GIS based Decision Support System (DSS) will be essential and important. GIS will also be an arena of technological and developmental edge. In the transforming world, nations that will possess a sound and progressive system of geographical information management will lead and chart ways in their own national and international arena far ahead of those that would use more traditional forms of information management.

In the above national perspective, it is imperative that** ……… **NATIONAL GIS IS AN IMPORTANT AND CRITICAL NEED.

1. Geographical Information System (GIS) is a system (of hardware/Software/data/applications/ policies) that deals with spatially referenced and geographically tagged/linked data. GIS allows analysis and integration of various map/image layers and geo-tagged tabular data to determine the spatial distribution (say, distribution of hospitals or distribution of flooding in a city and so on), the relationship between the spatial distribution (say, distribution of hospitals to roads or flooding spread to Emergency Centres and so on), and the correlation of the variables (does population correlate with land use or the correlation between soils, slopes, land use to determine the sediment yield in a reservoir and so on) in a geographic unit. Further, the capability of GIS systems now allows creating map visualization of tabular data and making amenable the spatial or map representation of population data, migration data, consumer data, financial transactions, and beneficiary data and so on.

2. Applications of GIS have great national relevance and can support governance activities, help prepare sustainable development strategies, involve citizens in participatory democracy, enable enterprises to manage business better and bring geographical knowledge to citizens.

3. In India, GIS technology is widely used and a good knowledge-base has been created over the years. GIS based initiatives of the Natural Resources Information System under National Natural Resources Management System (NNRMS); National Spatial Data Infrastructure (NSDI) of Department of Science and Technology (DST); Bhuvan Image Portal of Department of Space (DOS); Delhi State Spatial Data Infrastructure(DSSDI) of Delhi State; National Urban Information System (NUIS) of Ministry of Urban Development (MUD); establishing G2G GIS by National Informatics Centre (NIC); recent efforts at modernization of land records under NRLMP; various City-GISs (example Mumbai, Bangalore, Kanpur, Kolkata and many others) and many other have been implemented. In addition, various GIS initiatives of the states have helped bring good examples of state-wide applications of GIS. Some private sector agencies have also been successful in implementing GIS solutions and in providing GIS services.

4. In spite of fairly wide usage of GIS as a technology, the potential of GIS has not been exploited for decision-support by planners, stake holders for governance-process, decision-makers, citizens and many others. Some of the above initiatives have certainly been successful to prove GIS application potentials through specific project objectives but GIS is yet to get assimilated and become a part of the process of governance, planning and nation-building in a significant manner.

5. In today's transforming world, nations that will possess a sound and progressive system of GIS will lead and chart ways in their own national and in the international arena far ahead of those that would be dependent on other nation initiatives for their national needs. A national capability in GIS is very much required for India to be independent and gain that essential technological edge in the international arena.

6. The major gaps that have been seen in the wide usage of GIS include:

   6.1. GIS is technology centric BUT needs to be Decision-centric – thereby powering decision making and this means that decision-makers – government, enterprises, citizens should be easily making use of a readily available GIS system that can help them to take better decisions. What is required is to make GIS "so easy to use" for the USER that it becomes a part and parcel of a governance and nation-building process.

   6.2. There is yet no availability of GIS-Ready data for the whole country and no agency in India has overall responsibility for this activity Thus the sustaining efforts of any USER to prepare GIS-Ready data (which is quite an involved technical activity) and gaining adequate insights into the ever-changing technology scene of GIS becomes over-whelming for a USER (government user) and inhibit its wider usage.

6.3. GIS as project implementations serve limited operational purpose as these projects have a shelf-life and do not get integrated into the process of governance and decision-making – thus not providing the continuity required.

6.4. GIS needs to come on to every person's desk – so that just like using documentation tools or database tools the person can easily use GIS tools for his work relating to government, enterprise or citizen-interface.

7. Consistent with the government's vision of bringing a new paradigm for governance and development with emphasis on participatory approach from communities and citizens, the vision of National GIS is aligned to enable a scientific mapping of the resources, needs and aspirations of beneficiaries and society, especially the most disadvantaged; support sustainable and spatial planning; assist quick and reliable monitoring of plan implementation and status of development; enable transparent systems for inclusivity of society and support real-time mapping of feed-back and redressal systems.

8. The National GIS is envisioned as a critical support to the national governance and developmental process, providing GIS support to many aspects of the national economic and governance process that would benefit the nation.

9. The goal is two-fold – one, to establish a "National GIS" as a technology platform and, two, to realise an organisational structure of Indian National GIS Organisation (INGO) that will be responsible for National GIS system, maintaining and operating the GIS Platform.

10. The major elements of the National GIS platform include following specific activities:

10.1. **National GIS Infrastructure** as a GIS Platform and the computing and networking infrastructure for the National GIS. The National GIS platform would be developed, hosted, and based in India. As part of the National GIS infrastructure, it is planned to position National GIS Dashboards for key dignitaries such as PM Office (PMO); Planning Commission and Cabinet Secretariat for high-level reviews/meets etc and promote the GIS usage to key dignitary-levels.

10.2. **National GIS Asset** has organised geo-database of the National GIS Asset and maintaining it. The National GIS Asset is proposed to be organized at two-levels - Seamless, nation-wide GIS content equivalent to 1:10,000 scale and pockets of "geo-stitched" city-level larger scale GIS Asset (wherever and as and when available). National GIS Asset includes ~41+ GIS Features and a wide range of ~15+ sectoral geo-tagged attributes/tabular data from census, demographics, planning and development, infrastructure and other sectoral datasets of ministries/states. It is also proposed to allow crowd-sourced geo-tagged data content into the National GIS as an additional

"citizen-layer" where citizens can populate their datasets grievance-points etc on the GIS frame.

10.3. **National GIS DSS Applications** enabling GIS Asset and Applications as a service for different ministries/departments in government; target groups in private enterprises and also for citizens. Some of the core GIS Applications are:

10.3.1. **Plan-GIS for Planning Commission** supporting the planning, monitoring and reviewing plans and development.

10.3.2. **GIS for Public services** as part of PIII services in various areas.

10.3.3. **Rural-GIS** for various rural development programmes of the Ministry of Rural Development.

10.3.4. **City-GIS service** to planning, management and development of ~5200 urban areas for Ministry of Urban Development.

10.3.5. **Roads Monitoring service** for PMGSY as well as a Roads-GIS for NHAI/ Ministry of Surface Transport

10.3.6. **Health-GIS service** as part of support to the Ministry of Health & Family Welfare

10.3.7. **Water Resources-GIS** for water resources management of Ministry of Water Resources

10.3.8. **Agri-GIS service** for the Agriculture and Farm sector through Ministry of Agriculture

10.3.9. **GIS for Disaster Management Support** for supporting management of disaster for NDMA

10.3.10. **GIS for Infrastructure sector** be they in roads and highways, rail systems, airport infrastructure or other social infrastructure.

10.3.11. **Env-GIS** for Environment and Climate Change monitoring of Ministry of Environment and Forests

10.3.12. **GIS for Aadhar** integrated with UID

10.3.13. **Census-GIS** for Registrar General of India

10.3.14. **Weather-GIS and ES-GIS** for IMD/MoES.

10.3.15. **GIS for Security** as a support for the security programmes of Ministry of Home Affairs.

10.3.16. **NE-GIS** for meeting the GIS data and DSS needs of MONER

10.3.17. **Coal-GIS** for Ministry of Coal for supporting coal mining activities

10.3.18. **HeavyIndustry-GIS** for Department of Heavy Industries

10.3.19. **NewEnergy-GIS** for Ministry of New and Renewable Energy

10.3.20. **Tourism-GIS** for supporting Ministry of Tourism

10.3.21. **Panchayat-GIS** in support of Ministry of Panchayati Raj

10.3.22. **Stat-GIS** for the Ministry of Statistics and Programme Implementation

10.3.23. **Power-GIS** in support of Minister of Power

10.3.24. **Steel-GIS** in support of Ministry of Steel and its mining PSUs

10.3.25. GIS data access applications for use for **Defence GIS** requirements.

10.3.26. Provide for private sector GIS applications to be hosted and published on the National GIS.

10.3.27. Citizen access to National GIS would be enabled through simple GIS Applications and integrated e-services.

10.4. **National GIS Portal** development as a single gateway access - with detailed modules of GIS Metadata search, GIS data access and GIS applications access by integrating the Applications

10.5. **Capacity building and training** whereby the GIS training to different ministries and user groups needs to be taken up. As part of the National GIS efforts, it is important to address the training, education and research needs as part of the overall capacity-building. It is important to enable national interventions for a knowledge innovation programme and "boosting" present institutional mechanisms of training, education and much needed research in GIS.

10.6. National GIS would comply with current national policies. It is essential to have a **National GIS Policy** for all GIS content and it should define how activities of GIS data usage and applications can be undertaken in the country. INGO would work closely with Department of Space, Survey of India and other data providing or user agencies to help position a pragmatic National GIS Policy from time-to-time.

11. National GIS is an important and critical national requirement and it is recognized that an organizational framework will be essential for bringing focus and for institutionalizing the National GIS and promoting the geo-spatial technology usage within government, enterprises and by citizens. It is important that an AGENCY IS MADE RESPONSIBLE FOR GIS IN THE COUNTRY.

12. It would be appropriate to position INGO as an organisation that has the flexibility and agility to meet the needs at various stages of development and growth of National GIS. The driving requirement of the GIS organisation is to shape and align all disparate components relating to geospatial information infrastructure, technology and services so far evolved in the country. It should have the primary mandate for the establishment, maintenance and operations of the National GIS and be responsible for GIS activities in the country.

13. INGO is proposed to be an arm of the Planning Commission. The INGO can draw best of the "two-worlds" – the checks and balances of the government system and the intensive performance drive and positive efficiency of the private-sector. INGO must develop with a

business-culture right from beginning as after the initial establishment stage the organisation would transform itself into a business model for growth and performance.

14. At the apex level, a National GIS Council (NGC) is proposed to be established and it would be the key strategy and policy body for guiding the activities of National GIS. The NGC could be chaired by (ICG Proposal: Hon'ble Prime Minister) with Deputy Chairman, Planning Commission as Co-Chair; Minister(s) of S&T and Planning; Adviser to PM on Public Information Infrastructure and Innovation; Cabinet Secretary and Member (Science), Planning Commission as Members.

15. At the operational level, a fully-empowered National GIS Board (NGB) could be the body for deciding, approving, overseeing and monitoring the activities of National GIS and INGO. The NGB could be Chaired by Member (Science), Planning Commission and have all relevant Secretaries - DST, DOS, Agriculture, Rural Development, Urban Development, Health, Planning Commission, Home, Defence, Mines, Earth Sciences, IT and others; selected state representation (as required) and selected international/national GIS experts (as required and on case by case basis) and CEO of INGO as its Member-Secretary. The NGB as a fully empowered body would guide, define procedures, approve and accord programmatic, procurement/contracting, hiring/recruiting, financial authorisations and oversight for the overall activities of INGO and ensure that national needs of GIS are coordinated across different ministries/departments and assimilated under INGO.

16. It is proposed to obtain the best GIS professional in the nation to head the INGO as its CEO. It is proposed that this is accomplished through suitable "search" process within India for this key position. To enable the high-level coordination and also for enabling autonomy of functioning and authority, it would be essential to position the CEO equivalent to Secretary, Government of India.

17. A team of ~50 persons could be contracted/recruited on term-basis as experts from government/private sector agencies, with best practices, to serve as Project Staff for the National GIS and INGO activities. Much of the work could be contracted through well designed RFPs and to private industry for implementation. Highly professional consultants could be engaged, wherever needed, to serve specific technical needs of INGO.

18. It is essential to adopt modern practices to drive the performance of National GIS and INGO - based on a set of established metrics/KPIs for measuring performance and by adopting a 360º evaluation for performance.

19. Right from beginning, it is envisaged that the success of INGO would be possible only if states/local bodies are also involved – as ultimately the management actions have to be

implemented by the states/local level. Thus, INGO could encourage states to set up State/ Local GIS and add-on GIS databases for governance/development of states.

20. INGO must be founded with a strong industry linkage and must establish National GIS and INGO activities in terms of manageable projects through private sector participation. INGO would also link with academia to further specific research in the GIS domain that will make National GIS more productive and more widely used.

21. Standardisation and Process definition would be key for the success of National GIS. The National GIS would, in fact, have a suite of national Standards – broadly two categories of Standards, namely:

   21.1. Basic GIS Standards for National GIS and its activities - defining the content and its characteristics of National GIS Asset; GIS database standards for the National GIS database, GIS Quality Standards etc

   21.2. Service Level Integration Standards: The success of National GIS is also dependant on the integration GIS services to other national services, database and applications (like E-Governance; ERP, CRM etc)

22. The National GIS Standards must be founded on principles of "open standards" and be "inter-operable" across platforms and systems and be neutral to any technology (thus, not being tied with any particular GIS or System technology). The National GIS Standards must be consistent) with international ISO TC211 standardisation efforts – especially as India is already committed to ISO/TC standardisation efforts through the Bureau of Indian Standards (ISO is a multi-lateral body for standardisation and India is represented by BIS).

23. Existing GIS Standards like NNRMS Standard of 2005, NSDI Metadata Standards of 2001/2009 and NSDI Exchange Standards of 2001; NUIS Standards of 2004 have been studied and can be easily updated/enhanced and integrated into National GIS Standards 2011 definition.

24. The following Standardisation activities would be required:

   24.1. National GIS Content Standard and a National GIS Content Thesaurus

   24.2. National Spatial Framework (NSF) definition. While WGS-84 datum can be standardised, it is important that the geographic projection be adopted by National GIS.

   24.3. National GIS Database Standard

   24.4. National GIS Quality Standards.

   24.5. National GIS Metadata Standard

   24.6. National GIS Applications and Services Standard

   24.7. National GIS Portal Security Standard.

25. INGO, at the time of implementation and based on design decisions, must also develop different GIS Process Documents that define the steps and methods for various activities – almost 11 practice documentations will be required.

26. Considering the importance and criticality of the National GIS Standards and also noting the continuously evolving nature of the technology, it would be appropriate to have a **Expert Standing Committee for National GIS Standards** – consisting of technical experts in the nation. Such a technical standing committee can be tasked to help INGO define, develop, review, update the National GIS Standards.

27. INGO must bring about "commitment" of Anchor Agency roles for some key expert agencies – say, SOI and/or ISRO/NNRMS for GIS Asset related activities; NIC for Infrastructure and GIS Apps related activities and so on. Anchor Agencies are critical as they have the expertise and human resources to undertake responsible coordination/supervision/QA/QC for specific elements.

28. Indian industry would have a major role to play in terms of offering high-quality, success-oriented, committed and cost-effective services and work with Anchor Agencies under contractual obligations to INGO. Private sector can undertake bulk of activities by taking up design and implementation processes.

29. Leading institutions of repute and knowledge-capacity could be brought in to undertake specialised performance assessment, policy reviews and provide forward-looking "think-tank" activities for National GIS.

30. Academia and training/education institutions (both in public and private sector) could be encouraged by INGO to undertake the capacity-building and research/training activities.

31. It is ESSENTIAL AND IMPORTANT that National GIS and INGO collate the NNRMS and NSDI aspirations by properly linking/integrating and ensuring that no duplication of efforts happen – this will have to be very clearly worked out at time of implementation of National GIS.

32. ICG suggests that any structural integration/dove-tailing of proposed National GIS structure and present NSDI structure is done at an appropriate level by Planning Commission.

33. INGO must build and develop close linkages with each user ministry to support organising respective ministry-specific GIS data needs; linking to National GIS and also developing applications for user Ministries. INGO would also address the training needs and provide all technical anchoring/procurement for any GIS support to users.

34. It is envisaged that Government funding for the establishment of the National GIS is an imperative – especially as it has the primary responsibility to establish the basic

GIS infrastructure that helps the nation, as a whole. A business model will become viable when the basic GIS infrastructure is established and it will be possible to attract private sector investment for National GIS operations.

35. The Implementation of the INGO and National GIS could be carried out in 3 major phases:

35.1. Preparatory Phase (through this ICG) (2-3 months for Visioning, design, standards characterization and approvals): Vision Task, wherein the intent will be to prepare a Blue-Print for the National GIS platform and allow for a smooth implementation. This activity would be completed by the Interim Core Group.

35.2. There would be a period of 1-2 months for necessary government approvals and the formal establishment of INGO (and positioning of CEO and a minimal level team to start with) – which can then start the National GIS activities. This is the start time "T" for all subsequent activities.

35.3. National GIS Version 1.0 and INGO (about 6-9 months from "T"): Starting with the establishment of INGO, implementation of the Pilot stage of National GIS by organizing National GIS Asset Version 1.0 using 1:50K NSF and available SOI 1:50K base with add-on of available thematic maps; develop and position key National GIS Applications (for few ministries - Plan-GIS for Planning Commission; GIS for Public Services and Rural-GIS for Ministry of Rural Development and others); establishment of National GIS Portal; implementing 2 National GIS dashboard for PMO and Planning Commission; initiate GIS Capacity-building activities and efforts for positioning National GIS Policy.

35.4. National GIS Version 2.0 (about 36 months from "T"): Building upon National GIS Version 1.0 by translating to 1:10k NSF (which has to be freshly done); establishing 1:10k National GIS Asset for whole country; develop and position full-scale National GIS Apps for governance, full-scale access to private GIS Applications and also National GIS Applications for citizen access; continue GIS Capacity-building activities; INGO to continuously service GIS needs of government agencies

36. Subsequent to this, the updation/maintenance cycle of National GIS Asset layers on a yearly basis (or determined cyclic basis) and further support for National GIS Applications would have to be taken up.

INDIA – CHALLENGES AHEAD …… AN OUTLOOK

India has a geographical area of about 3.29 million sq kms and a population of 1.2 billion, of which an estimated one third lives in urban areas. India has more than 6.40 lakh villages and more than 5200 cities/towns. Land under active agriculture in India extends to about 1.4 million sq kms but still one-sixth of its total area in wastelands. With just about 22% under forest/vegetation cover and a coastline of ~7500 kms, the environmental and ecological challenges are many.

India is on a path of progress and growth. Despite the challenges of a large population, the nation has achieved sustained growth all-round. As per Panning Commission's assessments ("Issues for the Approach to the Twelfth Plan", which is accessible at http://planningcommission.nic.in/plans/planrel/12appdrft/12appdrft.htm), GDP growth for the 11th Plan is likely to be 8.2%. Agricultural growth has improved; there has been progress in poverty reduction and also that in the areas of health, education and upliftment of society. As India plans for the next 5 years, a key issue facing the country is to map the growth of the country. Planning Commission has proposed a target of 9-9.5% in the referred document. But challenges are many, including need to maintain agricultural growth, growing demand for infrastructure, growing skill shortages, environment and natural resources, particularly energy and water.

What are the imperatives that Planning Commission envisages for the 12th Plan? An inclusive growth strategy is being charted with focus on:

- Better performance in agriculture (at least 4% growth).
- Faster creation of jobs in manufacturing. We should specify a target for extra jobs to be created in this sector in next 5 years. This will be worked out in greater detail, but at its heart lies our ability to spread industrial growth more widely.
- Creation of appropriate infrastructural facilities in a widely dispersed manner to support the agricultural and manufacturing growth required.
- Rural connectivity is particularly important - especially in the backward areas and NE.
- There must be a much stronger effort at health services, education and skill development – making a new genre of knowledgeable Indians
- Reforming the government to increase effectiveness of flagship programmes and in achieving the objective of greater performance and productivity.
- Special challenges focused for vulnerable/deprived groups and backward regions. The need for a special focus on "backward" regions is urgent.

Looking even ahead, with a 2011-12 GDP expected to be around 2 trillion USD, it is possible that Indian GDP would approach $9-10 trillion by 2025. This sustained growth of the economy would be powered largely by domestic demand and the transformation to a highly industrialized and

technologically advanced economy. With such a level of economy, developmental activities in India will demand a new paradigm and thought-process and India's geo-political presence as a dominant economic power will be significantly impacting within and even globally.

India will make a significant difference in the coming years in the world scene.

India will have to be significantly different –transforming its process of planning, implementation and development. In the coming years, Governance regimes will need considerable change – moving from the traditional allocation systems to determining equitable systems. With large amount of socially-powered development, governance and public delivery systems will have to be more based on a scientific mapping of the needs/aspirations/desires and limitations of the beneficiaries and society, especially the most disadvantaged; built on transparent systems of inclusivity of citizen participation and entitlements; guaranteed development/service delivery with high-level of accountability of governance systems and a very effective (feed-back) and responsive redressal system. The concepts of Total Quality Management in governance/public services will have to be introduced at all levels – from top of governance to the bottom grass-roots level.

India will need professionally managed and performance oriented governance/delivery organizations with clear mandates, accountability and metrics of measuring performance. Technology will have to play a large role in the governance systems – almost keeping pace with the rapidly changing technology regimes across the world. Governance will have to be more effective, speedy, performing and results-oriented with goal-setting at all levels. Much better mechanisms for "converging" or "integrating" the multifarious over-lapping activities of departments and making "agile" and re-generative organisations will have to be positioned. A new thinking of governance structures is called for.

India will require a vastly different information regime to arm itself for the trillion-level of economy – powered by very efficient national information systems that will have to be the foundation for the governing and the governed – bringing the assessment of development needs, bridging disparity and gaps, bringing equity, transparency, inclusivity and citizen participation. Advanced information systems with technologies of metrics and measurement of disparity/needs/plans/implementation etc; advanced computing and data mining; special technologies of databases etc will be extremely important.

One such area is Geographical Information Systems – surveying/imaging/mapping; geospatial databases with geo-tagged tabular data; integrative geographical applications that will form a GIS based Decision Support System (DSS) will be essential and important. GIS is an important technology area which brings vast benefits to governing systems and also to the stakeholders (citizens) by bringing about the geographical depiction of disparity (gaps/needs) and development. GIS forms

the basis of a DSS that is powered by latest image and map information and transforms reaming tables into graphic maps.

GIS will be an arena of technological and developmental edge. In the transforming world, nations that will possess a sound and progressive system of geographical information management will lead and chart ways in their national and international arena far ahead of those that would use more traditional forms of information management.

In the above national perspective, it is imperative that .... **NATIONAL GIS IS AN IMPORTANT AND CRITICAL NEED.**

1. INTRODUCTION

1. Geographical Information Systems (GIS) are systems (of hardware, software, data, applications and policies) that deal with spatially referenced and geographically tagged or linked data. Over the past 40-50 years, GIS technology has evolved into an "integrating" technology that encompasses surveying & positioning, map-making and cartography, imaging and image interpretation, databases, computing and networking technology. Applications of GIS are varied and support natural resources management, disaster management, planning and development, environmental management, land and water management, ocean and marine research, climate change and many other areas where people, society are involved. Thus, GIS has become not only an important technology but is also becoming a tool that assists in governance, development of society and supports citizen activities.

2. GIS allows integration of multiple maps/image with geo-tagged tabular data and enables determine spatial patterns and choice based on spatial criterions. For example, GIS allows to determine the spatial distribution of features/objects (say, distribution of hospitals or distribution of flooding in a city and so on), the relationship among entities in a spatial distribution (say, distribution of hospitals to roads or flooding spread to Emergency Centres and so on) and the correlation of multiple spatial variables (does population correlate with land use or the correlation between soils, slopes, land use to determine the sediment yield in a reservoir and so on) in geographic space (say, in a district, a watershed or a nation or the whole Earth itself). Further, today's GIS systems allow creating map visualization of and making amenable the spatial or map representation of tabular data – say, population data, migration data, consumer data, financial transactions, and beneficiary data and so on, thereby allowing creation of population maps, consumer maps and their visualisation.

3. Applications of GIS has seen a quantum jump with its integration on the Web platform - which now provides a GIS engine and front-end GIS interface to any users on a simple browser. From a technology perspective, the GIS Web component can interface with any type of client - desktop, mobile or Web and serving GIS maps and GIS Applications prolifically to a large community of users. GIS users can now create pervasive geographic knowledge – their own maps, their GIS models and their own workflows and decision-rules and Geo-web services can deliver this GIS knowledge to everyone and, thereby, help better understand data correlations in spatial format and therefore help in better decisions to be made.

4. Applications of GIS have great social and national relevance and can support activities of government, enable enterprises to better manage business processes and bring important geographical knowledge to citizens. Thus, GIS has considerable impact on the economies of local, regional, and national governance and development - by creating greater efficiency in information understanding, more visual communication for better comprehension of information and better decision making by information integration.

2. STATUS OF GIS ACTIVITIES

5.   In India, GIS technology has been in use from 1980s and a good knowledge-base in GIS has been created over the years. GIS is being used in many government and private organizations and large number of GIS application projects have been implemented. With the availability of multi-resolution satellite images; topographical and thematic maps (forest maps, geological maps, groundwater maps, soil maps etc), many GIS based initiatives have been implemented. Notable ones are the Natural Resources Information System under National Natural Resources Management System (NNRMS); National Spatial Data Infrastructure (NSDI) of Department of Science and Technology (DST); Bhuvan Image Portal of Department of Space (DOS); Delhi State Spatial Data Infrastructure(DSSDI) of Delhi State; National Urban Information System (NUIS) of Ministry of Urban Development (MUD); G2G GIS by National Informatics Centre (NIC); recent efforts at modernization of land records under NRLMP; various City-GISs (example Mumbai, Bangalore, Kanpur, Kolkata and many others) and many others. In addition, various states have also undertaken GIS initiatives to support state-level projects. Of late, many private sector GIS projects have also been successful in the commercial domain. All of the above have helped in creating a good knowledge- and user-base of GIS in the country.

6.   **TABLE-1** shows the characteristics of the major GIS efforts in the country. The table lists a sampling of agencies that have significant and comprehensive GIS related activities and are mentioned here to more illustrate the wide-range of our national capabilities in GIS.

7.   In the last decade, many nations have considered a "cooperative sharing" framework for maps and images under the Spatial Data Infrastructure (SDI) concept – where map/image data generating agencies agree to share their maps/images as per defined standards. India too embarked on a national SDI (NSDI) in early 2000s and from 2005 onwards a NSDI Secretariat coordinates the SDI activities under the Department of Science and technology. However, the framework of SDI is becoming more of a sharing-platform of map generating agencies (putting up whatever maps are generated) and serves limited manner for usage of GIS by user agencies/ministries/citizens as part of a decision-making process. Thus, the SDI concept has been seen as unable to bridge the ever-existing gap between what map/image data is readily available with what GIS image/data the decision-process requires. Many advanced nations have realized this gap and recognize that a nation-wide, seamless GIS data that is readily available is required and is fundamental to make GIS a part and parcel of decision-process. Some advanced and developing nations, like, USA, China (China has gone ahead and established a multi-agency framework for a national GIS in China), Australia, Brazil, Indonesia and some others, are already in the process of extensively working on a nation-wide GIS and also in establishing a GIS which supports its government and citizens with most advanced decision-support mechanisms.

8. **TABLE - 2** shows a summary of how some nations are undertaking geo-spatial data/ applications services.

9. In spite of fairly wide usage of GIS as a technology in India, the potential of GIS has not reached where it can make a major impact – for governance, decision-makers, citizens and many others. While the present GIS efforts have certainly been successful to prove GIS potential and have achieved several project objectives, GIS is yet to become assimilated and part of the process of governance, planning and nation-building in entirety. The capability of GIS as a Decision Support tool in making qualitative and significant difference to decisions of government has not yet been exploited.

3. IMPORTANCE AND RELEVANCE OF GIS FOR INDIA

10. Applications of GIS can be critical to many aspects of governance and nation building and can help in reaching the gains of development to the most needy people at the most needy locations in the most scientific and transparent manner. Thus, GIS can power and support open-governance methods by involving citizens, opening up information in easy-to-understand map formats and also assist to bring in accountability and responsibility of public and governance activities. Applications of GIS not only benefit domain of societal governance but also in areas of governance in national security and strategic areas. At the same time, GIS can also help enterprises by enabling spatial solutions in support of their enterprise activities (be it in private participation of national-building or in the efficiency of businesses). Citizens too can benefit from the GIS by enabling the mapping of their aspirations, demands, complaints and suggestions and become important stake-holders in national development.

11. There is tremendous focus for growth in the country and the drive is to achieve it in a sustainable and rapid manner. Achievement of these goals will crucially depend upon the quality of decision making at all levels – the demand will be for scientific, sustainable and participatory decision-making that can satisfy society and improve the quality of life at all levels.

12. GIS plays an impacting and expanding role in supporting decision making process. Hence, when it comes to GIS **focus must be on Decision Support and emphasis must be on improving quality of DECISION MAKING.**

13. GIS can be a major differentiator for decision-making at all levels of governance and nation-building – be it in government, in enterprises or by citizens; be it central, state or local-body levels or be it for long-term planning or for immediate decisions. In fact, GIS must be able address all the hierarchical levels – national, regional and state level and then going down to district and Panchayat level and also covering all government, enterprise and citizen needs.

14. GIS is not just about images and maps, but must include a whole host of spatial data representation of geo-tagged developmental data tables - all of which comprises the "integrated" GIS-content for the nation. It must be recognized that in just producing best satellite images or best topographic maps or best forest maps etc is just half the problem addressed for a GIS Decision Support. Unless these are fused with large volumes of development data of government the second half of the Decision Support is not bridged. Today, with such a readily-available and easily-usable "integrated" GIS content not available in the nation, our national decision-process is always denied of this crucial differentiator and decisions not only lack the benefit of the GIS approach but are also unable to even exploit the benefits that can accrue from the simple usage of images and maps.

15. Structurally, the government is organized in sectors – thus data collection and mapping is also sectoral – BUT what GIS can do is enrichment of information by integrating across these "sectoral systems" into an integrated data system. Such an "integrated" GIS dataset can be easily super-imposed and correlated to bring to fore new geographical-data relationships and patterns, hither-to unavailable, and not just bring scientific perspective of decisions but also help determine the right decision-alternatives right down to grass-roots level. This will enable making better and qualified decisions and help sustainable development with a participatory approach.

16. Presently, there is one major "deterrent" that a prospective user of GIS faces in India. India today lacks GIS-Ready data which is most current and which a USER can easily access and use (though pockets of GIS-Ready data maybe are generated by some agency in specific project mode). In spite of the high-quality satellite images, large amount of survey and mapping in form of topographic map, forest maps, census data or even image data etc, this gap of organizing all of these into GIS-Ready form still exists. Thus, either the prospective GIS USER has to put tremendous efforts each time in organizing GIS-ready data from these maps/ images for Decision Support activity. So, many a time, even if a USER wants to use GIS for decision-making, he may be discouraged by the tremendous technological "processing" one has to get into – and thus may not really exploit the potential of GIS to support his decision-making.

17. There is yet another major aspect that needs to be addressed to make GIS a part and parcel of the decision-process. If GIS has to be embedded into a work- or decision-process, then it needs to be assured that the GIS-Ready data is constantly updated and so that currency of data is most recent for the governance process and usage. Further, new sets of GIS-Ready data that becomes possible with advances in GIS technology – say, maps on 1:10k scale or larger; re-surveyed land ownership data; terrain data on 3D; underground assets GIS data in cities; crowd sourced data and so on must also get assured to the GIS USER and continuously improve the GIS Decision Support services over time.

18. Enabling a wide usage of GIS based Decision Support also requires building policy environment for GIS over and above the existing present policies and create an "integrating" and over-arching policy framework. While government has the Remote Sensing Data Policy, 2011 for dissemination of Remote Sensing images and the National Map Policy, 2005 for usage and dissemination of SOIs topographic maps, these basically address the individual, but important, elements of images and topographic maps dissemination. However, as has been emphasized GIS is much more than just images and SOI maps. There is no clear definition of policies and guidelines for the range of GIS activities that are essential for the Decision Support – both from GIS data and applications service provision and GIS data and applications usage point

of view. Thus, there is a need for a comprehensive GIS Policy which over-arches the existing images and topographic maps policy definitions but also covers the gamut of activities of a GIS and that would promote and encourage wide GIS usage.

19. It is appropriate to institutionalize the GIS activities under an organisational focus that can be responsible and focus on addressing the technological, GIS data and applications services, inter-organisational and policy aspects of GIS. Presently, each ministry/department or user entities attempt to address on their own the GIS activity which is quite a technology-intensive activity and requires down-stream geo-processing and GIS knowledge for organizing the GIS. As a result, multiple effort investments are happening in maintaining the GIS data capability by each ministry/department and the same GIS-data is being generated/maintained by each of the ministry/department. This leads to large-scale duplication and redundant efforts leading to tremendous national-level data inconsistency in an unsustained manner. There is a need for a single-window ORGANISATION for generating/maintaining the map/image and GIS data-sets as a common GIS-ready data for the nation and also for developing the GIS Applications for ministries/departments. This would eliminate the multiple efforts and can enable ministries/departments and users to avail the GIS Decision Support that would be tuned to each ministry/department decision-process.

20. From a global perspective, GIS is becoming a critical capability that provides of technological edge to nations. In today's transforming world, nations that possess an advanced and progressive system of GIS would lead and chart ways in their own national and in the international arena far ahead of those that would use more traditional forms of information management. GIS technology is gaining critical importance in the international and multi-lateral frameworks – like, addressing cross-cutting issues of environment, rivers/drainage systems, borders, climate change and even in homeland security cooperation and in defence (particularly as defence equipment and systems are based on geospatial technology usage). A national capability in GIS is very much required for India to be prepared with its own GIS-ready data, satellite images, GIS Applications and GIS infrastructure. Thus, it is essential that the nation enable itself in GIS technology with a knowledge capability that will not only help bring benefits of GIS to its own national development efforts BUT also give it an edge in the international arena. A national GIS will provide that technological edge to India in the international arena.

21. In summary, the key questions that need to be addressed are:

21.1. how can the nation ensure that its decision/governance process is supported by a comprehensive, easy-to-use GIS Decision Support System that brings scientific, participatory and quality into decisions, planning and development

21.2. how can the nation ensure that GIS-Ready data is easily available and maintained – by adding a capability over the images and maps that have been invested in

21.3. what institutional mechanism is required in the country that can be responsible for this critical technological and applications capability of GIS and that can be charged to meet the GIS needs of the country and bring the technological edge in the global arena.

4. VISION OF NATIONAL GIS

22. Consistent with the government's vision of faster, sustainable and more inclusive growth, National GIS will help bring a new paradigm for development with emphasis on participatory approach from communities and citizens and support a new model of governance. Within this larger national goal, National GIS is envisioned as a critical support to the national governance and developmental process, providing GIS Decision Support Systems (DSS) support to various aspects of economic and social development and governance processes. National GIS is envisaged to enable a scientific mapping of the nation's resources, needs and aspirations of beneficiaries and society, especially the most disadvantaged; support sustainable and spatial planning; assist quick and reliable monitoring of plan implementation and status of development; enable transparent systems for inclusivity of society and support real-time mapping of feed-back and redressal systems.

23. The National GIS would be a part of new participatory governance models at local, state and national levels involving government officials, society and citizens; bring accountability and responsibility in actions; promote commerce and business; enable citizens access GIS services and also make the society, at large, to become spatially aware and knowledgeable.

24. The National GIS is therefore a "public and merit good" - serving good for larger majority. The National GIS is "mission critical" for national and state government, enterprise level GIS activity and should also provide a premise for future public and private collaboration within India in the critical area of GIS.

25. National GIS is envisioned to:

    25.1. be a major support to GOVERNANCE by embedding GIS in different aspects of governance - planning and implementation at national/state/local levels; bringing GIS support in decision-making; enable a sound process of monitoring development and identifying "gaps in development"; make GIS data available at all levels – that helps bringing accountability and responsibility in governance.

    25.2. support the accelerated development of a number of Enterprise-GIS solutions being undertaken by private enterprise and help align these to national development – by allowing integration of the National GIS into enterprise solutions in an appropriate manner and also contribute innovative GIS software and data content/applications for larger and wider use.

    25.3. serve the basic needs of citizens by serving nation-wide maps/image/geo-spatial information; geo-enabling e-governance and public services and also enabling a "crowd-sourced" interactive process of citizen involvement in providing feed-back/inputs/data as a virtual geographical ingest.

26. National GIS must get embedded in all aspects of Planning at national/state level; agricultural development; support disaster management needs; water resources management; managing climate change; planning of landuse and land records ; urban management; planning better infrastructure facilities; development of Watersheds; watch and scan of the Environment and empower citizens and communities for better participating in planning and development. This will require more effective coordination and cooperation amongst different government agencies to align and focus synergise the GIS data requirements and applications across the government sectors.

27. Through the Planning Commission, the government should ensure GIS usage across its many ministries, agencies and departments prepare the 12th Plan proposals on the backdrop of a National GIS and also deliver ministry/department services on the GIS Platform.

28. India is embarking on a Public Information Infrastructure (PIII) as a backbone for e-services and PIII's e-services must be enabled on the National GIS platform to serve the basic needs of citizens, citizen services of e-governance (such as e-Health, e-Legal, e-Files, e-PDS, e-Registry, NREGA and many others). Citizens could also benefit from access to map and image information and simple applications like routing, tourism etc.

29. The National GIS should also enable the accelerated development of a number of Enterprise solutions that power and support many enterprise activities and which can draw "uniform" GIS-Ready data from the National GIS - for enterprise solutions in power, telecom, infrastructure, aviation, port management and many other sectors. These Enterprise solutions often grapple with a combination of varied technologies (including GIS), varying standards for data and its quality (which are many times unknown) and developing different and fragmented applications which have to be managed in an enterprise environment. A standardised National GIS – dove-tailed with standards of other systems would enable a tightly coupled and seamless integration facilitating GIS enabling of the enterprise solutions.

30. The National GIS, thus, can be a "common GIS platform" and a GIS Systems of Systems - for the support of national and state governments, enterprises and others with proper in-built safe-guards of guarantees of services, security, access, copyright and revenues at the foundation of the National GIS.

31. It is proposed that the National GIS be established through a dedicated and responsible organisation. A dedicated organisational structure for India's National GIS will not only bring a focused, mandated drive to organize and maintain/update the GIS but can also easily dove-tail the GIS into a national mainstream of planning/governance, nation-building and citizen-participation. This organisation will help bridge the gap that exists today for GIS-Ready data.

32. It is envisaged that an organisational focus for the National GIS will give a great boost to GIS technology in the country and will ingest much-needed growth to the technology by ensuring

its wide usage. This new organisation can also involve the private sector and challenged it to offer proficient and innovative GIS services and create growth of business opportunities in GIS in the country. It is envisaged that National GIS can also give a boost to academic and research activities in GIS and give a thrust to innovative and new education/research activities.

33. Through such an organisation focus, India would be able to gain a pre-eminent position in the global GIS community and this will help India to play a leadership role in global multi-lateral and international GIS arena.

34. By establishing a National GIS, the nation would benefit in various ways:

   34.1. Improved efficiency of decision-making, planning and development actions by the powerful GIS DSS Applications engine that would allow ministries/departments, citizens etc embed GIS applications as part of their decision- and work-processes. Therefore, Government ministries/departments can deploy sectoral (say, Agri-GIS; Rural-GIS and so on) GIS-DSS easily. Ready availability, accessibility and service of a GIS-Asset for the whole nation of as a collection of standardised, inter-operable, seamless and maintained GIS datasets

   34.2. Improved planning on a GIS DSS applications suite supporting national Planning and Plan Monitoring functions of Planning Commission;

   34.3. Serve unique e-services on the GIS platform for citizens as part of PIII;

   34.4. Availability of national (Indian) Standards for National GIS datasets, Standards for GIS web services, Standards for GIS data exchange, Standards for GIS Quality, Standards for GIS Metadata and others.

   34.5. Position "volunteered geographic information" through crowd-sourcing transactional workflows that allow citizens/individuals to easily add GIS content to the National GIS Asset;

   34.6. Growth to private sector participation in GIS activities by offering efficient GIS Applications as an all-inclusive support to development activities;

   34.7. Position India in a leading role in international GIS arena and enabling a larger role-playing by India in this critical technology arena in the world.

5. SCOPE AND OBJECTIVES OF NATIONAL GIS

35. The overall scope is two-fold – one, to establish the National GIS as a "GIS Platform" through, two, an organisational structure of the Indian National GIS Organisation (INGO). In tandem, both of these will make the Vision of National GIS a reality and bridge the existing gaps in positioning GIS Decision Support and enabling governance, planning and development.
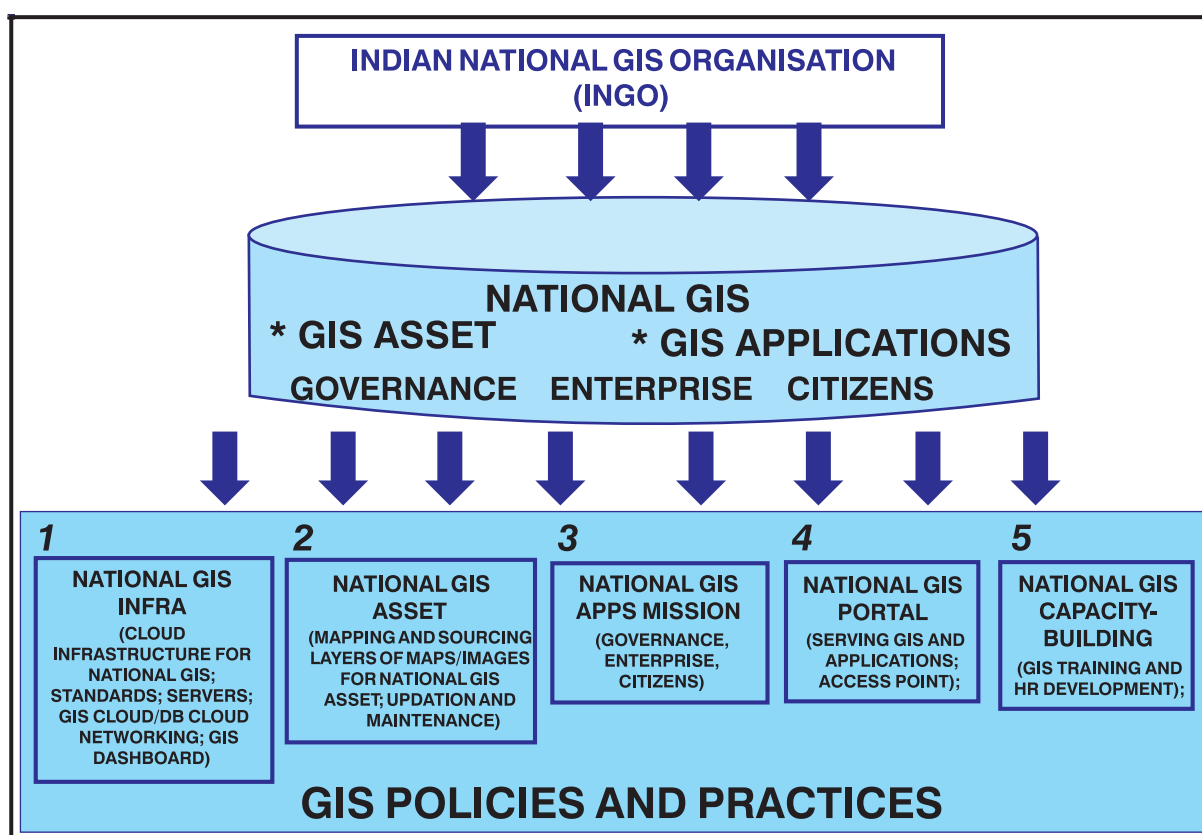
5.1. NATIONAL GIS

36. Six major elements of the National GIS are envisaged – all of which in a holistic manner will establish the nation-wide GIS. These six elements are:

   36.1. National GIS Infrastructure, a state-of-art computing and networking infrastructure for hosting/serving the National GIS Asset and serving National GIS Applications

   36.2. National GIS Asset, a seamless, nation-wide GIS-Ready dataset which is standardised and updated and configured to meet the GIS data and application needs of government, citizens and enterprises.

   36.3 National GIS DSS Applications, a suite of GIS applications for decision- and work-processes of different ministries/departments in; enterprises GIS applications and GIS applications for public services and citizens.

   36.4 National GIS Portal, a single gateway access to National GIS Asset and National GIS DSS Applications - with specialised Metadata service, ingest and publishing services etc

INDIAN NATIONAL GIS ORGANISATION (INGO)

NATIONAL GIS
* GIS ASSET   * GIS APPLICATIONS
GOVERNANCE   ENTERPRISE   CITIZENS

1 NATIONAL GIS INFRA (CLOUD INFRASTRUCTURE FOR NATIONAL GIS; STANDARDS; SERVERS; GIS CLOUD/DB CLOUD NETWORKING; GIS DASHBOARD)

2 NATIONAL GIS ASSET (MAPPING AND SOURCING LAYERS OF MAPS/IMAGES FOR NATIONAL GIS ASSET; UPDATION AND MAINTENANCE)

3 NATIONAL GIS APPS MISSION (GOVERNANCE, ENTERPRISE, CITIZENS)

4 NATIONAL GIS PORTAL (SERVING GIS AND APPLICATIONS; ACCESS POINT);

5 NATIONAL GIS CAPACITY-BUILDING (GIS TRAINING AND HR DEVELOPMENT);

GIS POLICIES AND PRACTICES

36.5　National GIS Capacity building, a sustained effort for training and orientation of users/ professionals from government and enterprise in GIS and for positioning an integrated programme of education and research in GIS.

36.6　GIS Policy management and practices, through a constant policy-definition and review that promotes GIS usage in the country and creates the environment for success of GIS activity in the country.

5.1.1. National GIS Infrastructure

37.　The National GIS Infrastructure must be developed as a state-of-art GIS Platform on which the GIS Asset and GIS DSS Applications would "ride" and through which the National GIS data and applications can be served. The infrastructure would be a bank of computing facilities, necessary GIS engine and other software, a high-capacity Data Centre, a comprehensive User Portal and an Administration/Management Portal with appropriate security and risk management solutions.

38.　National GIS Infrastructure must be architectured with a long term perspective and be able to support the National GIS activities not just for next few years but for decades ahead. The facility must be state-of-art that will significantly add to enhance national capabilities in GIS technology and applications.

39.　Configurations of the GIS infrastructure at a broad-level have been studied by ICG through an expert team of system experts in the country. In considering the architecture, the following important aspects have been considered:

39.1.　The GIS Asset is composed of datasets generated by various agencies- and thus could be hosted on agency systems accessible and seamlessly integrated into the GIS Asset OR on INGO systems with INGO datasets that are generated by INGO. Thus, data servers could be at different places and in different agencies – with a main INGO hosting-server of GIS Asset.

39.2.　The National GIS Applications are also to meet specific governance, enterprise and citizen demands. While governance demands would be end-to-end GIS Applications; enterprise Applications would be those that are published and made available by enterprises (and having a commercial nature) AND citizen Applications would be free-to-use e-services and public GIS Applications.

39.3.　In addition, it is also pragmatic for government to consider moving away from Capital Expenditure (CAPEX) model for infrastructure, which requires each and every government and other organizations to make considerable and continuous investments in GIS Data Storage/Centers/Systems to a probably suitable Operating

Expenditure (OPEX) model so that the large number of government agencies that use National GIS can be freed from the one time investments and overhead costs of maintenance that is felt as a major barrier for many government agencies and enterprises in getting benefitted from GIS usage. The concept must be that users just USE and all other support to ORGANISE is not a user-burden.

40. The "tight-binding" of data and applications will require a virtual-seaming of the infrastructure across agencies/regions and users – making the concept of infrastructure virtualisation immensely important. Virtualising a distributed architecture for National GIS would bring in consistency of systems, data and applications – reducing efforts at maintaining data consistency, maintenance and also providing seamless access.

41. In an expert assessment carried out under ICG, it is envisioned that a government-owned infrastructure in a private "cloud architecture" could be most appropriate – considering each ministry/department, enterprises, citizen data and applications as services provided on the "cloud". It is envisaged that India could benefit from cloud-models for its government and other services – thus embedding "pay-for-use" concept for its IT and National GIS services – users can pay for GIS-DSS applications services OR pay for GIS Asset data access services OR pay for use of National GIS Infrastructure services (wither GIS engines, database engines or even hardware) OR pay for customized/dedicated GIS services. Appropriate access rules can be defined so that variable cost-principles are implemented for government access (as government has funded the National GIS), citizen access (sponsored by government due to its aims of making these services as a national commitment) and enterprise access (charged on commercial basis).

42. A National GIS platform is envisaged to play a major part in addressing significant improvement in government and enterprise and citizen GIS service delivery. The GIS Cloud can significantly help government departments to straightaway deliver services in easy manner and even integrate the National GIS with other national IT systems based on ERP, CRM and Office automation tools.

43. The infrastructure could be structured as a multi-tiered platform with a front-end having of the National GIS Portal offering various "GIS data and applications services", a back-end high-capacity Data Centre that stores the GIS Asset and a series of servers architectured to maintain security and controlled access to the GIS Application services. This would also require a high-bandwidth national network (as the National Knowledge Network (NKN) can be a possibility), which manages the high-capacity data traffic of the infrastructure.
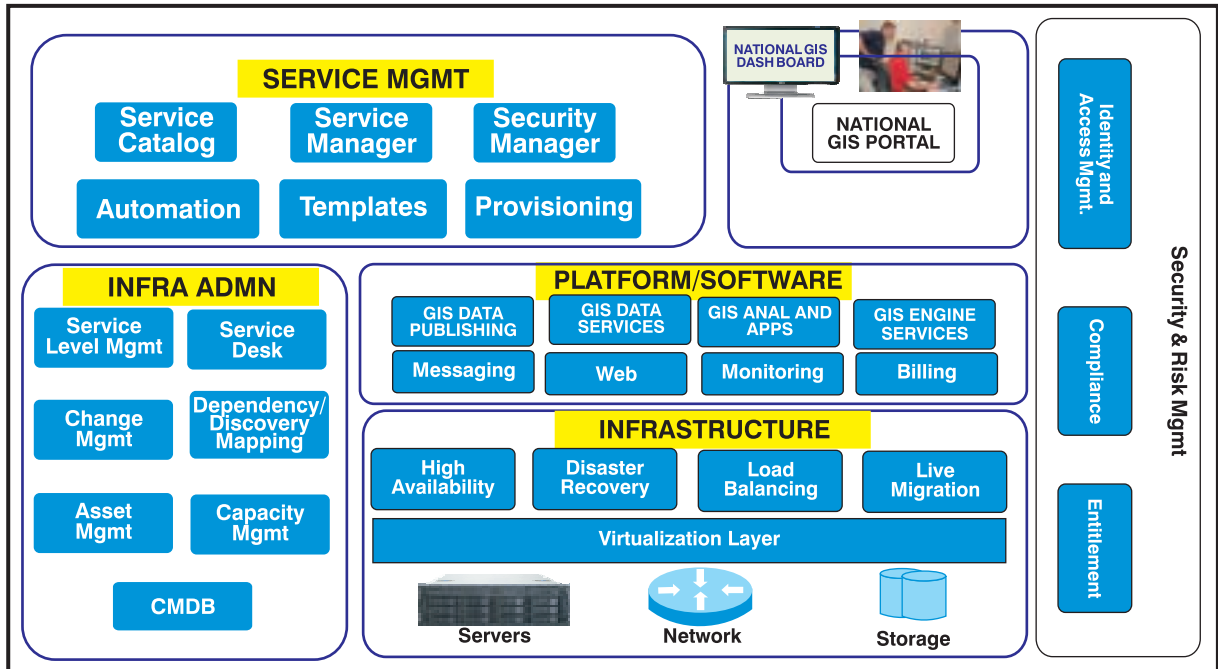
44. The National GIS Infrastructure must be developed, hosted, and based in India with appropriate. With focus on services, appropriate Business Process Continuity and disaster recovery mechanisms would have to be built-in – not only to safeguard the National GIS Asset but to also provide GIS Data and Application services on 24X7 basis.

45. INGO must be charged to design, architecture, establish and maintain the GIS platform using best capability available in the country. It is envisaged that a National GIS Infrastructure Access Protocol (NGIAP) be defined by INGO for access for data providing agencies, government agencies, enterprises, citizens etc and also define the cost-recovery rules for each of these – based on principles of need-to-access or commercial or societal obligatory considerations. The National GIS Infrastructure would be made accessible to government, private enterprise and citizens for the GIS as per NGIAP.

46. Broad details of the National GIS infrastructure are given in **TABLE-3.** At the time of implementation, INGO must be able to work out detailed design and architecture of this National GIS Infrastructure and also operationalise the infrastructure in a phased manner.

5.1.1.1. National GIS Dashboard

47. As part of the National GIS Infrastructure, it is planned to position National GIS Dashboards for key dignitaries such as PM Office (PMO); Planning Commission and Cabinet Secretariat (if other ministries/departments also require the Dashboard the same could also be implemented) through a GIS Control Centre (GCC). The National GIS Dashboard would enable viewing maps and images of any region and allow fusing of various data – thus, becoming a

part of information-assimilation process in map format displays for key dignitaries in governance. It would be appropriate to adopt these dashboards for high-level reviews/ meets and promote this GIS usage at key dignitary-levels.

48. The GIS dashboard would include a set of specialised hardware, display systems and a suite of GIS applications software. Specialised GIS Dashboard Applications would be configured that will allow status monitoring, planning and reviews on the National GIS view. The GIS Dashboard Applications could pop-up various abstract-scenarios and situational awareness and display maps (like Project Status GIS Application; Disaster GIS Application; Crop Status GIS Application; NREGA status GIS application and many others), images and other spatial data. The GIS-Dashboard would serve maps, tables, text and applications from the National GIS. Key datasets can be used to show graphical views of statistics. Information can be displayed in tables, charts, and thematic maps.

5.1.2. National GIS Asset

49. In any GIS of relevance, content is most important and core to the wide usage of the GIS across wide spectrum of users. Nations that have widely accessible content have seen growth in GIS usage and GIS business growth – fuelling a new enterprise of success in the environment (examples of this are UK, USA, Japan and more recently nations like China and Brazil are also undertaking such a nation-wide GIS activity).

50. The National GIS Asset is proposed to be organized in a seamless manner at two-levels:

50.1. Nation-wide GIS content equivalent to 1:10,000 scale mapping (scale is the most common form of information content referred by users; in a digital GIS domain scale is a "misnomer" but more relevant is information content or depth of information) and use of 5.8m/2.5m/1m IRS (or appropriate) images

50.2. Pockets of "geo-seamed" city-level larger-scale GIS content (wherever and as and when available) for urban areas where larger depth of information content would be available.

51. **TABLE-4** shows the list of National GIS Asset and their details of content, updation required (as most of these are of old vintage and none are updated). It is to be noted that larger the scale of information (or, say depth of information content), the greater will be the dynamics of information, making it challenging to keep it updated. However, a reference time-frame for updation has been identified for the GIS Asset. Cycles of updation of the National GIS Asset could be organized by using satellite images and by surveying.

52. National GIS Asset includes ~41+ GIS Features and a wide range of ~25+ sectoral geo-tagged attributes/tabular data from census, demographics, planning and development, infrastructure and other sectoral datasets of ministries/states. It is also proposed to allow
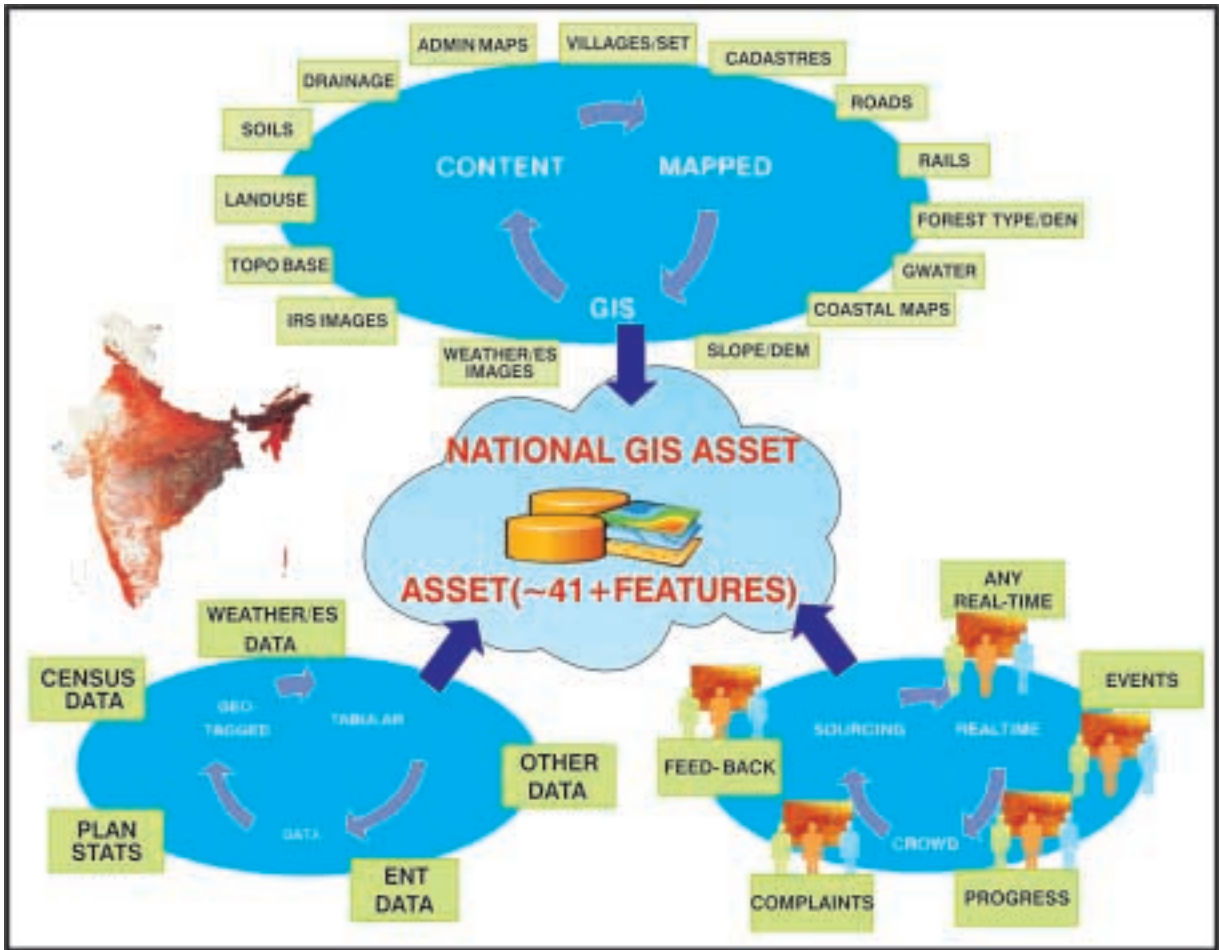
crowd-sourced geo-tagged data content into the National GIS as an additional "citizen-layer" where citizens can populate their datasets/grievance-points etc on the GIS frame.

53. There is no single agency in India which has ready to use comprehensive GIS Asset with nationwide scope. Thus, building the GIS Asset will have to be taken up from the point of available maps/data to organise the first-time GIS Asset for the country.

53.1. Many of the features, individually, would be available from data generating agencies in map form (like SOI, GSI, FSI, NBSSLUP/Census; some may even have some GIS data for some regions/areas – but not for whole country and in updated form). The "maps", even if they are in digital format, are not GIS-Ready and require considerable process and efforts to make them GIS-ready and ingested into the National GIS Asset. However, this still could be a major input for National GIS Asset.

53.2. Considerable efforts would have to be enabled by INGO, with involvement of data generating agencies, to make the GIS-Ready data for the National GIS Asset. This would involve appropriate map-to-GIS conversion and GIS-readying processes to be adopted.

53.3. All the features would have to be updated to current time-frame and maintained for National GIS on a regular basis by positioning a systematic data-updation cycle for National GIS Asset. To ensure this, INGO would have to take on a responsible and leadership role.

54. While these ~41+ listings are the present list of National GIS Asset content, it must be planned that, in future, the content of the National GIS Asset would be constantly reviewed/ modified by INGO, based on national needs and demands, and the National GIS Asset could get expanded. Thus, in this manner the National GIS Asset can include any-level of map/ image/geo-tagged dataset – ALL ON ONE NATIONAL FRAME.

55. As of now, the nation (through SOI) has a 1:50k spatial framework based on available 1:50k toposheet foundation. This can be a starting point BUT it is important to establish a National Spatial Framework compatible for 1:10k National GIS Asset and base all GIS assets on this framework. It is essential for these 2 frameworks to be positioned immediately. It should be ensured that a National Spatial Foundation Dataset – consisting of national/state/districts/ taluka boundaries linked to Census names is available as a common and foundation base data for National GIS.

56. The National GIS Asset would be organized as per National GIS Standards. **TABLE-5** lists some of the most critical parameters in the standardization domain.

57. INGO must be mandated to get organised, develop, maintain and serve the National GIS Asset. INGO, nominally, may not generate any maps or undertake any basic survey that agencies, like SOI, GSI, NBSSLUP, Census etc are already undertaking (these agencies would anyway continue to be the primary survey and map generating agencies for topography, geology, soils, census and so on). Today, in the nation, some private agencies also generate/ create maps and survey data (which are being used) – and, if required, these could also be ingestible into National GIS Asset – provided all of these map data comply to National GIS Standards.

58. INGO could get the GIS Asset organized (as per the adopted National GIS Standard) by either of these 3 methods:

58.1. Sourcing available and usable digital maps and geo-tagging of tabular data from government agencies (like SOI, NRSC, NBSSLUP, AISLUS, CWC, CGWB, TCPO, Census, Planning Commission and Ministries, states etc); private agencies (like MapMyIndia, Navteq etc) and any others that have already generated the map/tabular data across the country. INGO could ensure that these sourced data elements are made amenable to ingest into National GIS Asset after ensuring compliance to National GIS Standards

and in a time-bound manner. INGO will have to work out the methods/procedures/ QA for "ingesting" these sourced datasets into the National GIS Asset and could involve the private sector to undertake these voluminous tasks.

58.2. In case of any GIS Asset element that is not generated/collected by any agency BUT there is a national need, INGO should then take up the task to initiate surveying/ mapping and initial data generation activity and ensure that such elements are also available in the GIS Asset. In fact, INGO could work with existing agencies (government and private) and contract on them to generate and supply these GIS data elements and ensure that such GIS data elements are quickly made available in National GIS.

58.3. Crowd-sourced data that is geo-tagged and available from individual citizens as GIS-Citizen apps.

59. Thus, while ensuring not to "displace" or "duplicate" the existing mapping/surveying activities of any department/agency, INGO must pro-actively take responsible and deliverable steps so that the National GIS Asset is constantly updated and meets national needs of GIS data.

60. INGO would have to develop and position some of these critical tools/processes:

60.1. crowd-sourcing technology on the National GIS platform

60.2. process of real-time and semi-automated data updating of National GIS Asset features

60.3. process for establishing correctness/validation when GIS data ingest happens into National GIS Asset and certifying the veracity of information holdings in National GIS Asset

61. The National GIS Asset must be available for National GIS Applications. The GIS Asset must also be available as a Data service to users (if they desire so) so that users could also set/ build up their own applications using the data asset.

5.1.3. National GIS Applications – A GIS-Decision Support System (GIS-DSS)

62. A GIS Decision Support (GIS-DSS) would be the basis for serving and publishing GIS Applications and by which users would discover and access a comprehensive set of GIS Applications in support of their decision making purpose. The GIS-DSS would be based on a single window GIS interface system - providing requested GIS data and relevant applications through closely integrated, yet loosely coupled multiple web-based decision support systems and web GIS services.

63. INGO must be charged to ensure development and operation of the GIS DSS Applications suite. INGO must work with ministries/departments to ensure that their respective GIS DSS needs are met and available. INGO must also ensure that enterprises can also make available their GIS DSS on the National GIS Infrastructure.

5.1.3.1. National GIS-DSS - Governance

64. It is proposed that the National GIS Asset would enable a series of specialised GIS-Applications for governance – basically a set of GIS Applications needed by different ministries and departments.

65. A very comprehensive initial assessment of GIS DSS requirements for governance, enterprises, citizens has been done through a process of wide user-level consultations. In detailed consultation meetings held with ministries/departments, private sector, academia and NGOs, 22 ministries/departments have defined their "GIS-requirement inputs" indicating specific DSS requirements. Similarly, several private sector agencies have also defined their perspectives of GIS DSS.

66. One of the important user of National GIS would be the Planning Commission with a core GIS Application for Plan-GIS (for Planning Commission) that would have planning, monitoring and reviewing applications of the Annual- and 5-Year Plans on the National GIS, apart from generating macro- and micro-indicators of developments as inputs to planning. Planning Commission must enable itself to utilize the GIS-based spatial planning for the 12th Plan and also encourage and motivate as many ministries of GOI to prepare GIS-based plans/proposals and use the National GIS within their own ministries.

67. Based on the consultation and inputs, the following 24 GIS Applications for Governance are identified (detailed scoping of each module could be worked out by INGO):

67.1 **GIS for Public services:** The National GIS could be the core for PIII services in the areas of e-Health, e-Legal, e-Files, e-PDS, e-Registry, NREGA and other public and citizen services. The GIS would be a basic layer that provides location-tag to all data, plans, programmes, citizen address and other entities.

67.2 **Rural-GIS,** with a focus on Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGS) and various rural development programmes of the Ministry of Rural Development. Ministry of Rural Development has identified the need for GIS based watershed planning and monitoring to be included. Watershed boundaries, contour, village boundaries, cadastral maps could be handy in deciding the actions to be taken on ground for watershed based development

67.3 **City-GIS service** to support Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and expanding on National Urban Information System (NUIS) - as the basis for any urban planning, management and development of urban areas for Ministry of Urban Development and mainly to support urban plan generation and urban management in all cities of the country. Some of the specific GIS Applications are Land and Natural Resources changes; Settlement Pattern analysis; Slums and Blighted Areas assessment; Urban Environment analysis; Re-densification of Towns/ Cities; Monitoring of Land Regulation and Urban Fringe; Transport Planning and Environmental Assessment and Safety. MUD proposes to extend its present NUIS scheme (which has just covered ~150 towns/cities out of 5200+ cities/towns in country) to cover all towns/cities – this can be done in integration with National GIS as content for NUIS Apps would get covered by National GIS.

67.4 **Roads Monitoring service** for PMGSY as part of a Roads-GIS for NHAI/Ministry of Surface Transport

67.5 **Health-GIS service** as part of support to National Rural Health Mission (NRHM) – for the Ministry of Health & Family Welfare. GIS Apps for disease surveillance, health amenities mapping, vulnerability analysis etc with GIS data on health amenities geo-tagged data, roads, health facilities, census/demographic data etc

67.6. **Water -GIS** (specifically mentioned by Ministry of Water Resources) as part of a National Water Resources Information System and supporting water resources management for the Ministry of Water Resources. Some important GIS Apps required would be for GW locating and diagnostic services, hydrological modelling, water-balance estimation, flow-estimations, reservoir capacity estimation, flood forecasting & flood inundation model; basin –wise assessment of water resources potential and others.

67.7. **Agri-GIS service** for the Agriculture sector - that can integrate natural resources of soils, water, fertility etc with ownership/cadastral data and also to agri-facilities data that includes credit, seeds, fertilizers etc and provide GIS advisories to Farmers for Ministry of Agriculture

67.8. **GIS for Disaster Management Support** of NDMA as an integrated system for supporting management of disaster for NDMA – including modules to disaster sensitivity/resilience; on-line damage visualisation; damage assessments and also rehabilitation programmes.

67.9. **GIS for Infrastructure sector** as a foundation for infrastructure development – be they in roads and highways, rail systems, airport infrastructure or other social infrastructure.

67.10. **Env-GIS** for Environment and Climate Change applications on a National GIS base: Generating an Environment Baseline GIS data for managing multiple types of environmental data (water quality, air quality and land quality) and global change data (carbon emissions, ozone, climate data, carbon credit etc) and Geo-tagged environmental data must be included. Enable full-scale monitoring of environmental parameters, identification of hotspots are important element of Env-GIS module.

67.11. **GIS for Aadhar** where the National GIS Platform is integrated with UID – geo-linking all citizen-ID to spatial assets – land, property etc and geo-tagged public assets – PDS, NREGS, banks etc. In specific, an interactive GIS application for residents enrolment/updation for Aadhaar; GIS profiling of Telecom Coverage to assist/design service delivery tools based on Aadhaar based authentication and GIS application for mapping Post offices throughout the country to help proper delivery of Aadhaar letters to residents are specified by UIDAI. These GIS Apps would require detailed GIS data at large scales in cities.

67.12. **Census-GIS** – a national GIS-based Census perspective for on-line 2011 Census data visualizations and patterns for Registrar General of India based on GIS data on Landuse, roads, buildings, amenities, village boundary, settlements etc

67.13. **Weather-GIS and ES-GIS** which would enable provision of weather and climate services and coastal zone management application services on Earth Sciences data on the National GIS frame by IMD/MoES.

67.14. **GIS for Security:** National GIS can also be the foundation for Securing and Protecting the nation – the National GIS can be integrated with the National Intelligence Grid, CCTNS, Maritime security and other security programmes of Ministry of Home Affairs.

67.15. **NE-GIS** (at the specific request of Ministry for NE Region) for meeting the GIS data and DSS needs of MONER and also for enabling the NE region to assimilate and

absorb these modern and essential techniques for planning and development. Some specific GIS Apps that are important are Road connectivity analysis, Hamlet Mapping, e-governance and public services in NE.

67.16.   **Coal-GIS** (specifically requested by Ministry of Coal) with specific GIS data and Applications needs for coal mining activities. GIS Apps for building terrain models for Blocks, Coalfields etc.; Query based information for coal deposits for taking quick decisions; Analyse/interpret geology, Seams, Mines, Surface features etc.; Buffering boundary core zone of mining project etc. For this, a customised and separate Coal-GIS Asset of MOC specific data needs to be organised of mine plans and other mining and coal details – linked to National GIS Asset.

67.17.   **HeavyIndustry-GIS** (specifically requested by Department of Heavy Industries). GIS is a new concept for Department of Heavy Industry. Keeping in view the large number of CPSEs under the administrative control of the Department of Heavy Industry, National GIS can help the department in efficient management of CPSEs, their lands/buildings, machinery and products. National GIS can also help in mapping of various CPSEs data to DHI data with specific GIS Apps for Industry cluster analysis; Industrial safety analysis; State-wise / location wise industrialization; Polluting industries; Green energy use analysis; Product supply analysis; Auto sector NATRIP- Testing facilities planning; Location wise labour analysis; Machinery management etc

67.18.   **NewEnergy-GIS** (specifically requested by Ministry of New and Renewable Energy) – with specific GIS Apps for Criterion Analysis for wind potential sites; Wind Roughness Analysis; Up-dating of Biomass Atlas; Performance monitoring of biomass power plant; Identification of feasible location of Biomass power plant; GIS Apps for solar energy etc. A customised and separate NewEnergy-GIS Asset of Ministry of New and Renewable Energy specific data needs to be organised of landuse, biomass, wind, terrain, industry locations and details – linked to National GIS Asset.

67.19.   **Tourism-GIS** (specifically requested by Ministry of Tourism) with specific GIS Apps for determining the suitability of locations for tourism development; developing tourist circuits/ destinations; optimum planning for tourism development; monitoring progress of sanctioned projects etc. A customised and separate Tourism-GIS Asset of Ministry of Tourism specific data needs to be organised of landuse, tourism assets data; terrain data; tourism spot locations and details – linked to National GIS Asset.

67.20.   **Panchayat-GIS** (specifically requested by Ministry of Panchayati Raj) – with specific GIS Apps for Planning and scheme Monitoring at Panchayat-level; Panchayat NR Accounting; Panchayat's Assets Management; e-service delivery; Grievance

redressal; Social Audit etc. A customised Panchayat-GIS Asset for Ministry of Panchayati Raj needs to be organised of panchayat level boundaries, Panchayat assets, schemes and projects – linked to National GIS Asset.

67.21. **Stat-GIS** (Specifically requested by Ministry of Statistics and Programme Implementation): GIS Apps that facilitate collection, compilation and dissemination of statistical data; undertake large scale sample surveys for collection of data on various aspects of Economy.

67.22. **Power-GIS** (Specifically requested by Minister of Power) which will include Power Utility GIS Apps for Building Energy Efficiency analysis, Landuse allocation, Power distribution, Appliances mapping and Labelling etc which will require GIS data on landuse, building-level, network assets, industries etc. This GIS Applications could also need integration with SCADA, CRM and other datasets.

67.23. **Steel-GIS** (specifically requested by Ministry of Steel for its mining PSUs and its ministry activities) which will include information needs on landuse information in mining areas (especially forest cover); water resources maps; mineral maps etc and GIS Apps for mineral resources like iron ore, coking and non-coking coal, chromium, magnesium etc and GIS Apps for mining areas management; lease demarcation and environmental impact analysis.

67.24. National GIS Asset could also be of use for **Defence GIS** requirements and appropriate one-way Data Exchange and Application services could be integrated to meet the Defence requirements with appropriate levels of firewalling and security provisions.

68. It is envisaged that Ministries would have to provide for their own Sectoral GIS Asset activity that would contain their sectoral/ministry GIS datasets and which would be linked to National GIS Asset as per the National GIS Standards. INGO would provide all technical and procedural wherewithals to Ministries for organizing the Sectoral GIS Assets.

69. INGO must be mandated to work with user ministries/departments so as to asses all the GIS-Apps that are required and ensure that these GIS DSS Applications are developed and operationally available to the users. In doing this, it is envisaged that INGO could utilize private sector contracting to get these assessments and GIS DSS-Apps software developed and maintained and could, therefore, generate standardised indenting/contracting procedures for all user related activities for GIS Applications.

70. In addition, INGO can also promote and further other ministries and states to develop state-based applications for state-level governance and spawn a series of state-GIS Applications – by involving appropriate state-level stake-holders. Almost all states have established a State Remote Sensing Applications Centre (SRSAC) – these could be tasked to interface with INGO and develop application linkages for using National GIS at state level.

71.	Some of the states like Andhra Pradesh, Gujarat, Maharashtra and others have developed considerable GIS Apps and they also have capability to support National GIS activities. State-level GIS Apps that have been suggested (INGO can also coordinate with all states and develop an interface for state-level GIS Apps on the National GIS Platform) are varied – Criterion Analysis for Environmental Sensitivity Index; MNREGS monitoring; Amenities location analysis; Visualisation Analysis for village-wise census data; Land Information System; Health Management; Disaster Mitigation Models for Cyclone, Flood & Drought; Groundwater prospecting; Tank Information system etc

5.1.3.2. National GIS-DSS – Enterprises

72.	It is envisaged that the National GIS Platform can also provide for private sector GIS applications to be hosted and published. There are many private sector agencies that would provide specialised GIS Apps – which they could ride on the platform and services provided. Examples of these are GIS Apps for Power Utilities, Telecom Utilities, specialised urban-tax applications, routing applications etc and these would be promoted. National GIS Asset would be accessible to allow private enterprises to build their own Enterprise GIS solutions/ applications - and even allow them to publish their Enterprise GIS data and Applications on National GIS. Some of the key sectors that private sector usage of National GIS would be possible in Power, Telecom, Infrastructure - Roads, Airports etc.

73.	Any commercial arrangements that are required for these enterprise GIS Application services would be as per separate agreements between INGO and private enterprise – detailing technical, legal and revenue-sharing terms.

5.1.3.3. National GIS-DSS – Citizens

74.	As part of the PIII, citizen access to National GIS would be enabled through simple GIS Applications of previewing any part of GIS Asset India, pre-viewing basic layers and images; undertake place-find applications, routing applications and so on.

75.	Even specialised citizen services like, Railway services, Transport Services could be served on national GIS - allowing seeing maps of routes etc. The scope of citizen services could be enhanced to include land records, city plans, e-governance services etc - which could be triggered by private visualisation and opportunity sizing. The Citizen services of National GIS should also enable people's interaction with governance and allow citizens to voice/ complaint/feed-back on location tags and enable a process of participatory democracy and people's involvement.

5.1.3.4. National GIS-DSS – Development Framework

76.	The GIS DSS frame work will be founded on National GIS Asset using web based GIS and database technologies with inherent extensibility for future growth. The framework would have to be based on a Service Oriented Solution architecture that would:

76.1. Enable simultaneous access of National GIS Asset and other data sources which could be based on diverse platforms and data formats without any data translations or system conversions.

76.2. Provide tools for seamless integration of both spatial and geo-tagged non-spatial features in National GIS Asset

76.3. Allows National GIS DSS administrators/users to develop and deploy GIS centric DSS using easy to use configuration and application tools. The end users will be able to avail integrated GIS and MIS functionalities using standard web browsers.

76.4. Support real time Localization. The National GIS DSS Applications frame work will enable administrators to configure multilingual capability.

76.5. Provide ready to use tools to dynamically fetch and display Web services or syndicated GIS feeds of disparate spatial and non spatial data from various sources.

76.6. Enable administrators/Application developers to establish connections to multiple non-spatial databases engines, creation and consumption of web services for selected tabular data using advanced configurable application enterprise suite.

76.7. Enable Database Audit to manage all data access audit configurations across the enterprise from a central console.

76.8. Provide tools for Security Management to configure data access controls, Role Based Access Control – and fine grained access control

76.9. The overall SOA based solution architecture will ensure that the ownership of the data could still remain with defined data owners. As and when new application and additional data bases are added, they coexist with earlier application.

5.1.4. National GIS Portal

77. It is proposed to establish a National GIS Portal as a national gateway for accessing all GIS services. All National GIS Asset access and GIS Application services would be through the National GIS Portal as a single gateway access - with detailed modules of Metadata search, National GIS Asset access and National GIS Applications access. The portal could segregate traffic of G2G and G2C/G2B access based on sign-on and log-on procedures with multiple authentication and verification process.

78. National GIS Applications interface would require Indian language front-end interface and thus language-localisation technologies would be essential for GIS DSS Applications.

79. The Portal would provide access based on a National GIS Access/Service Policy (NGAP) – which would outline how and what area of National GIS government (categorized to specific ministry area access and general government access); registered private and citizens can access.

5.1.5. National GIS Capacity-Building

80.   Ministry of Human Resources Development (MHRD) Task Force of 2010 has determined that geospatial professionals would be required in the country at 5 levels:

80.1.   A wide programme of making school children well knowledgeable with geospatial technology at high-school level.

80.2.   Large number of user community in government (state/central); private sector and even citizen-service providers that would be the user base for national GIS activities in the country. These would require 1-2 week orientation to use GIS Application services for their processes and for their activities.

80.3.   Geospatial skilled work-force – a category of large number of human resources required for meeting the "pyramid-base" as the large work-force for survey/mapping/ GIS operators etc. This requirement can be met by more professional training through special training programmes.

80.4.   Technical Geospatial Professionals - large number of geospatial professionals who have specific training and knowledge for specific tasks – these form the "pyramid middle". These are the specialised training by private industry and technical institutions in the country.

80.5.   Good number of Geospatial Experts who specialise in geospatial technology and form the "pyramid top". These are basically BTech/MTech in Geomatics/GIS Science etc from the University systems.

81.   The MHRD Task Force in its draft report has mentioned the GIS resource requirements for India, including for National GIS, in the next five years as given below:

Geospatial Activity	Survey/ Mapping/ Trained skill-workforce	Trained workforce for Survey/ Mapping, Geo-database and GIS Apps	Educated professionals for Survey/ Mapping, Geo-database and GIS Apps	Trained users development who would be users	School-level awareness
Present Availability Estimate Estimated Additional need by end of 2015	~15000-20,000 ~20000 @4000-5000 per year	~6000-10000 ~15000 @~2000-3000 per year	~800-1200 ~5000-8000 @~1000-1500 per year	~25000-50000 ~500,000 @~50-100K per year	NA Estimated in phased manner thru NCERT/ State School Boards

Geospatial Activity	Survey/ Mapping/ Trained skill-workforce	Trained workforce for Survey/ Mapping, Geo-database and GIS Apps	Educated professionals for Survey/ Mapping, Geo-database and GIS Apps	Trained users development who would be users	School-level awareness
Knowledge/ Skill-interventions required	Industrial Training in specific Geospatial Operations (2-4 weeks)	In-depth specialised training in operations/ managing (3-12 months)	4-Year Graduate/ 2- Post-Graduate/ PhD in Geospatial Technology thru University	User Training on specific GIS apps operations (1-2 week orientation)	Basic chapters in 9-12 science curriculum; Additional GIS Kit knowledge exercises
Min Qual for knowledge/ skill interventions	10th OR 12th Grade school	Graduate in Science/Arts Or Diploma in Comp Apps	12th Grade leading to BTech/ BTech leading to MTech/PhD	Basically a Geospatial technology user in Central/State governments	School at 6-8 AND 9-12 Grade
Knowledge Credits	Professional Certificate	PG Diploma	BTech OR MTech OR PhD	Applied Certificates	Proficiency Certificate

82. As part of the National GIS efforts, it is important to address the above strategy for creating the knowledge base of GIS in the country.

83. While MHRD can initiate its own GIS education and research programmes for schools and universities, these would bring significant impact over few years with GIS knowledge embedded in the future generation. However, there is an urgent need to address the present large number of professionals and decision-makers from government and private sector with basic knowledge of National GIS so that they are tuned and oriented for using GIS process flows in their decision- and work-processes. This must be addressed by INGO.

84. It is important to position such national interventions for a knowledge innovation programme and "boosting" present education/research and training mechanisms in GIS.

5.1.5.1. Training Needs: National GIS Capacity-Building

85. Training will be a very important element to make the National GIS widely used and also get embedded into the nation's governing, development and democratic processes. It is envisaged there would be a large number of professionals in the government (both centre and states), private sector and even common citizens who have to have customized and relevant orientation/training and outreach so as to be "GIS literate" and for being able to adapt and use National GIS solutions within their own work-practices. It was noted that while the numbers may be large, the depth of training and outreach would be broad and of user orientation-type to make the users/professionals knowledgeable to use and practice the National GIS solutions in their work.

86. With above in mind, INGO would have to initiate a large capacity-building programme (estimated at training 500,000 professionals over 5 years atleast) and could involve existing institutions (public and private) involved in Training and Capacity-Building.

87. A mission mode would be required to address this requirement. It would be important to undertake a continuous drive for Training/Orientation within government and enable a capacity-building programme in the country that can also cover private enterprise (on commercial terms) and citizens/academia/schools. A concerted effort for training to different ministries and user groups needs to be taken up. INGO could enable a network of institutions, technologies (including satellite based instruction and training), standardisation of basic curriculum for training/orientation – thereby, playing the role of a critical-agent for achieving this goal.

5.1.5.2. Education Needs: National GIS Capacity-Building

88. In a long-term perspective for National GIS, it would be essential to have a school-level programme for GIS awareness and knowledge – this must be aimed at making our next generation GIS-aware and thus preparing them to develop and sustain the National GIS activities. National GIS must include a concerted programme to "ignite the GIS spark" for school level students by incentivizing and facilitating GIS education at schools. Such an activity can be taken up by MHRD and involving INGO.

89. There are quite a few universities that have geospatial education leading to MS, BTech/BE, MTech and some to PhD programmes also. However, the major challenges these institutions face is that they lack modern facilities and do not create the ability to modernize and upgrade constantly, lack teaching faculty that is upto-date and have not yet made the thrust for a career orientation for the university education. This needs urgent attention and reversal by way of a boost to university level education – which MHRD can consider positioning with technical support from INGO.

90. It is important that an Inter-University Centre for GIS Education and Research is established by MHRD to integrate the universities under a "knowledge umbrella" and bring focused education and research in GIS to fore. Such a Centre would help build and maintain leadership in knowledge pool in the country and build technological edge and leadership in the area of GIS. MHRD could establish such an Inter-University Education and Research Centre and INGO could help MHRD on technical aspects.

5.1.5.3. Research Needs: National GIS Capacity-Building

91. There is considerable gap of high-quality research in GIS technology and applications. This, in fact, is causing a limitation in building the knowledge base in GIS and also developing

indigenous software/solutions in GIS. It is felt that if a good and high-quality GIS research is enabled within the existing university system then the nation would benefit much more by way of creating a fundamental knowledge base in GIS and also enabling the nation to benefit from GIS in terms of good applications and also would enable the nation to maintain leadership in the international arena. The Inter-University Centre must work on these lines.

92. Advanced GIS research is required in many areas – related to standardization, ontology, 3D GIS, Representation theory, Graph Theory, Topology, Geographic Information System (GIS), Spatial analysis, Spatial autocorrelation, Complete spatial randomness, Modifiable Areal Unit Problem, Cartography, Geo-visualization, Spatial Decision Support Systems, Cellular automaton, satellite remote sensing, airborne remote sensing, geodesy and developing gravity model for India, cartography and mapping, re-defining Indian Mean Sea Level (MSL), adjusting Indian Great Trignometrical Survey, photogrammetry mapping, developing an Indian Terrestrial Reference Frame within the framework of the International Terrestrial Reference Framework and transformation model between Indian reference system and ITRF, Geographical Information System (GIS), global positioning system (GPS), electronic surveying, laser scanning, mobile mapping, image processing, algorithms, data structures and computer programming, application modelling research, cost-benefit research, research in social aspects of GIS, GIS Policy research and many other areas.

5.1.6. National GIS Policy

93. National GIS would comply with current national policies – even as there is a recognition that the GIS related policies must constantly and regularly be reviewed and updated frequently (especially as EO and GIS technology is changing rapidly; it would be even appropriate to have a standing National GIS Policy Review Committee that annually reviews and considers changes, as required).

94. There are already existing policies for Remote Sensing data (RSDP), topographic maps of SOI (Open Series Map Policy) and efforts are also ongoing to define and position a Data Sharing Policy. It is envisaged that National GIS Policy would specifically address the GIS aspects – even as RSDP continues to define policy for availability of RS images and OSM continues to define how topographic map data of SOI would be made available. It may be also that ministries/departments would define their own "policies or guidelines" for their datasets and these would be continued. But National GIS Policy must clearly define how a GIS content is assimilated, made available, updated and maintained for the country. It is envisaged that in defining the National GIS Policy, INGO could bring an "integrating" and "over-arching" framework with RSDP and OSM and other policies – thus bringing a "virtual" integration into a single GIS Policy.

95. The GIS Policy must basically address for the growth of National GIS in India for a broader usage of geo-spatial technologies and conducive to manifest benefits from GIS in a wider

manner (even as the Remote Sensing Data Policy and National Map Policy are being reviewed separately).

96. It is essential to have a National GIS Policy on the following principles:

96.1. One harmonised Policy framework for all GIS content and its use - be it maps, survey data, satellite/aerial Images and so on AND should define how activities of GIS data usage and applications can be undertaken in the country.

96.2. Access to and use of any available GIS content and applications must be governed by "criteria of use" rather than any limiting-principle. Proper Do's and Dont's and mechanisms are to be worked out with appropriate Service Level Agreements (SLA) and response-metrics for demand of map/image/GIS data in the country.

97. It will be essential that INGO steer and manage this National GIS Policy formulation and its sustenance on a continuous basis. INGO could work closely with Department of Space, Survey of India and other data and user agencies to help position a pragmatic National GIS Policy from time-to-time.

5.2. IMPLEMENTING NATIONAL GIS – AN AGILE ORGANISATION STRUCTURE: INGO

98. National GIS is an important and critical national requirement and it is recognized that, unlike a specific project, an organizational structure will be essential for bringing focus and institutionalizing the National GIS and geo-spatial technology usage within government, supporting enterprises and for our citizens. Just like national census activities for the nation is coordinated by a separate Census Organisation; space activities are coordinated under a separate Space department; energy needs of nation are coordinated under a separate Energy ministry and so on, it is essential to have a separate organisational structure for the GIS needs of the nations in the form of an Indian National GIS Organisation (INGO).

99. Having a separate organisation for GIS is important for the following considerations:

99.1. GIS technology has matured and impacts many national activities and the nation's GIS also influence the external environment in many ways. Thus, a holistic view for a national GIS is essential.

99.2. National GIS must be continuously updated and maintained and then only it is useful for governance and its citizens. Such an updation/maintenance activity cannot be taken up in project mode (as is done by the relevant ministries/departments) but in an organisational mandated manner.

99.3. It is essential that an AGENCY IS MADE RESPONSIBLE FOR GIS IN THE COUNTRY – that addresses all aspects of end-to-end domain of GIS (whether it is GIS data/asset; GIS

Apps; GIS Policies; GIS Training and establishes a full-scale GIS practice in the country within government.

5.2.1. INGO – An Agile Organisation

100. In the context of government's drive for a modern approach to accountable governance, it would be appropriate to position INGO as a new flexi- amoeba-organisation that has the flexibility and adaptability to the needs at various stages of National GIS (what organisational capability may be required when National GIS first gets established may be different from the organisational capability that would be required when National GIS has to be maintained/operated). Thus, INGO would be a "project organisation" sizing and re-sizing itself on a continuous (annual) basis based on tasks and activities. INGO is envisaged as a trim-and-slim organisation of best GIS experts in the country and functioning totally based on efficient sourcing tasks through private sector participation – for which efficient and standardized RFP/contracting process would get positioned drawing best practices of government and private sector. Further, it would also be appropriate to bring a business-like outlook and performance-based organisational structure for INGO – where performance and achievement as per defined plans will determine its growth and success. Thus, INGO must have all the flexibility that performance-measures demand (in terms of flexibility in resources, manpower hiring/contracting, merit-oriented remuneration attracting best GIS talents etc).

101. The driving requirement of the GIS organisation is to shape and align all disparate components relating to geospatial information infrastructure, technology and services so far evolved in the country towards establishing an integrated National GIS and to enable its reliable operations and maintenance subsequently.

102. A high degree of contemporary technical skills and multi disciplinary expertise are required in the organisation of National GIS. Secondly, the new GIS organisational focus would be based on, as emphasised, a lean and flexible set up to meet "establishment" requirements during development phase and then smooth transitioning into an operational phase. This highly compact and professional organisation can best take advantage of the specialisation and expertise developed in various government organisations as well as industry.

103. Thus the proposed structure will consolidate the gains of expertise developed in the country on the one hand and incorporate state of the art features on the other. In order to achieve this, management structure should be enabled by a clear mandate for delivery of overall National GIS system, meeting all performance specifications. It should facilitate efficient and effective decision making process while being fully accountable.

104. In developing a multi user oriented system like National GIS with seamless, state of the art features and meeting stringent service level standards, it is necessary to build in autonomous functional capability in the organisation to be able to deliver goods under (i) varying

environment of end user demands and (ii) to be resilient to any dislocation in supply of inputs. Modern concept of flexible organisation must be adopted, incorporating performance metrics and conforming to highest quality in its class.

105. The compact, flexible organisational concept also brings in synergy of networking and collaboration and endeavours to avoid any burden to the government from large pool of permanent employment of human resources. Thus organisation will be capable of sizing and re-sizing itself on a continuous basis based on tasks and activities.

106. With agility the key to INGO, at any stage it would be possible to structure INGO from a project-based/agile organisation and turn it into a more firm organisation as the need may arise in the future. In the same concept, it would be easily possible to up/down-scope INGO.

5.2.2. INGO's Mandate

107. The INGO must have the primary mandate of being responsible for the establishment, maintenance and operations of the National GIS and, in specific, have following tasks:

107.1. Enable and ensure establishment, organisation and continuous maintenance of the National GIS Asset as a seamless, nation-wide geospatial database on a common, standardised, easy-to-interoperate geospatial standards by sourcing (as available from any mapping and content creation agency), ensuring generation (if need to be generated) and integrating the maps/image frames into a GIS Ready Asset.

107.2. Develop and encourage National GIS content and GIS-DSS applications services for governance, enterprises and citizens and also support the planning/monitoring requirements of Planning Commission and also support the e-services of the PIII. In specific, INGO must support GIS Application needs of ministries/departments and could enable a process by which these needs are met – so that value of GIS for meeting the national needs are maximized from a technical/cost-effective/procedural point of view.

107.3. Establish a National GIS Portal through which access to these National GIS asset, GIS-DSS Applications and other technological advancement is provided to the national as a National Service.

107.4. Promote capacity-building in GIS and HR development through training and orientation of professionals and supporting national focus on research and education innovation in GIS technology and applications in India. In specific, training and capacity-building in ministries/departments would be most essential.

107.5. Establish and maintain an infrastructure that supports National GIS - from mapping, images, databases, access and applications with a 24X7 service arrangement.

107.6. Develop, manage and position the right policies and environment for furthering GIS activities in India

107.7. Enable development of GIS apps/tools/software etc and maintain a national repository of such research and technology developments for posterity and as a knowledge bank.
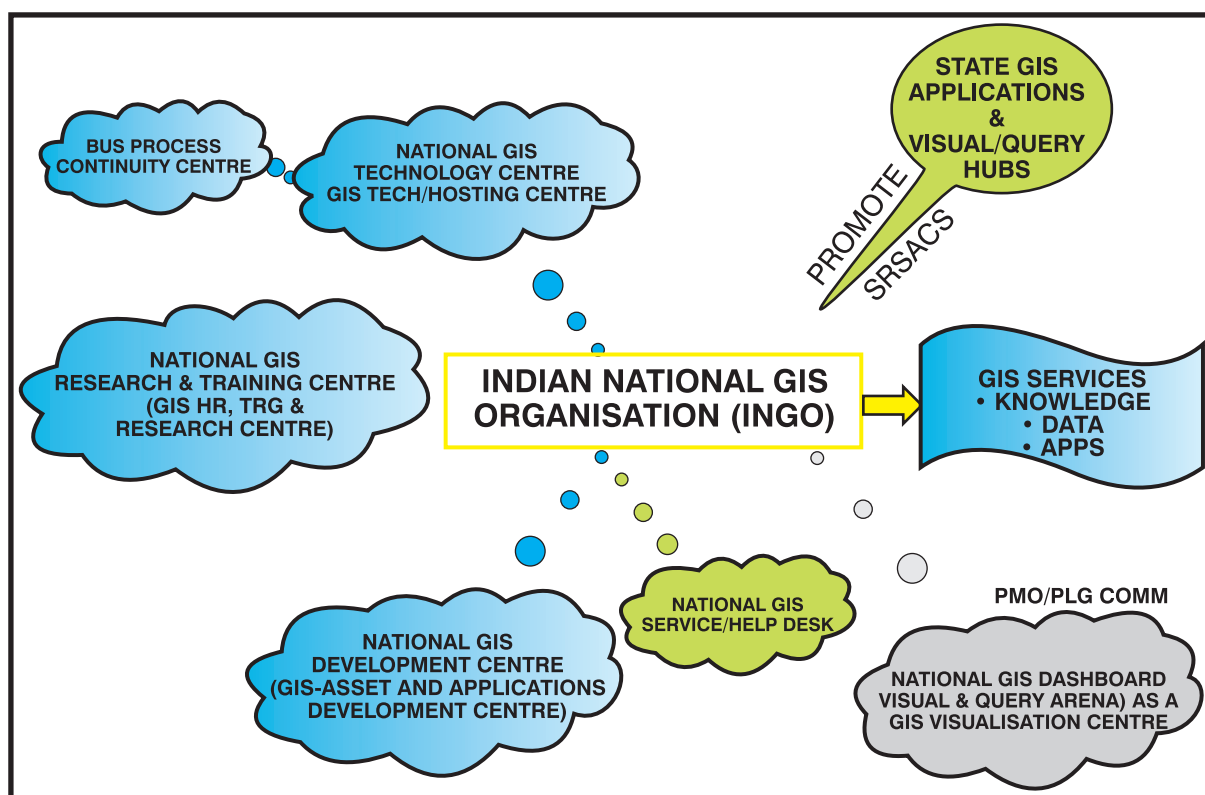
5.2.3. Structure of INGO

108. INGO is proposed to be an arm of the Planning Commission. The INGO could be established as an **"experiment"** in modern organisational framework and be a model for a separate and innovative mechanism - to give it the high-level focus and drive that is required. The INGO can draw best of the "two-worlds" – the checks and balances of the government system and the intensive performance drive and positive efficiency of the private-sector. The INGO must be a very agile organisation with a tremendous capability to re-scope and re-define constantly as required for the activities to be undertaken – as against a rigid/fixed structure that can impede speed of action and also performance. THUS, INGO MUST BE MORE A MISSION-ORGANISATION – which focuses sharply to defined objectives and tasks in hand. The advantage of such an approach would be that the organisation is very flexible and would be "non-permanent" and could be easily re-scoped for newer/modified mission objectives to be achieved as per a specified performance measure.

109. INGO must develop with a business-culture right from beginning as after the initial establishment stage the organisation would transform itself into a business model for growth and performance. Thus, identification of performance metrics for each and every activity would be most essential; human resources would all be on contracts that encourage excellence and performance and thus only performance would determine continuity of

contracted staff; strongly incentivise performance so that the motivation for staff to perform is always well defined and transparent; obtain best professionals to serve on appropriate contracts for INGO where remuneration would match the industry/market standards demanding performance and excellence.

110. INGO's role is critical for futuristic national development for supporting governance, industry and citizen services. It is an objective and key tool for planning and assessments on implementation. Its use thus cuts across several line ministries within government and also organisations/people outside the government – thus making the Planning Commission a suitable place for its "anchoring".

111. To be able to fulfil its mandate, INGO has to be given adequate autonomy and authority, along with ensuring its accountability.
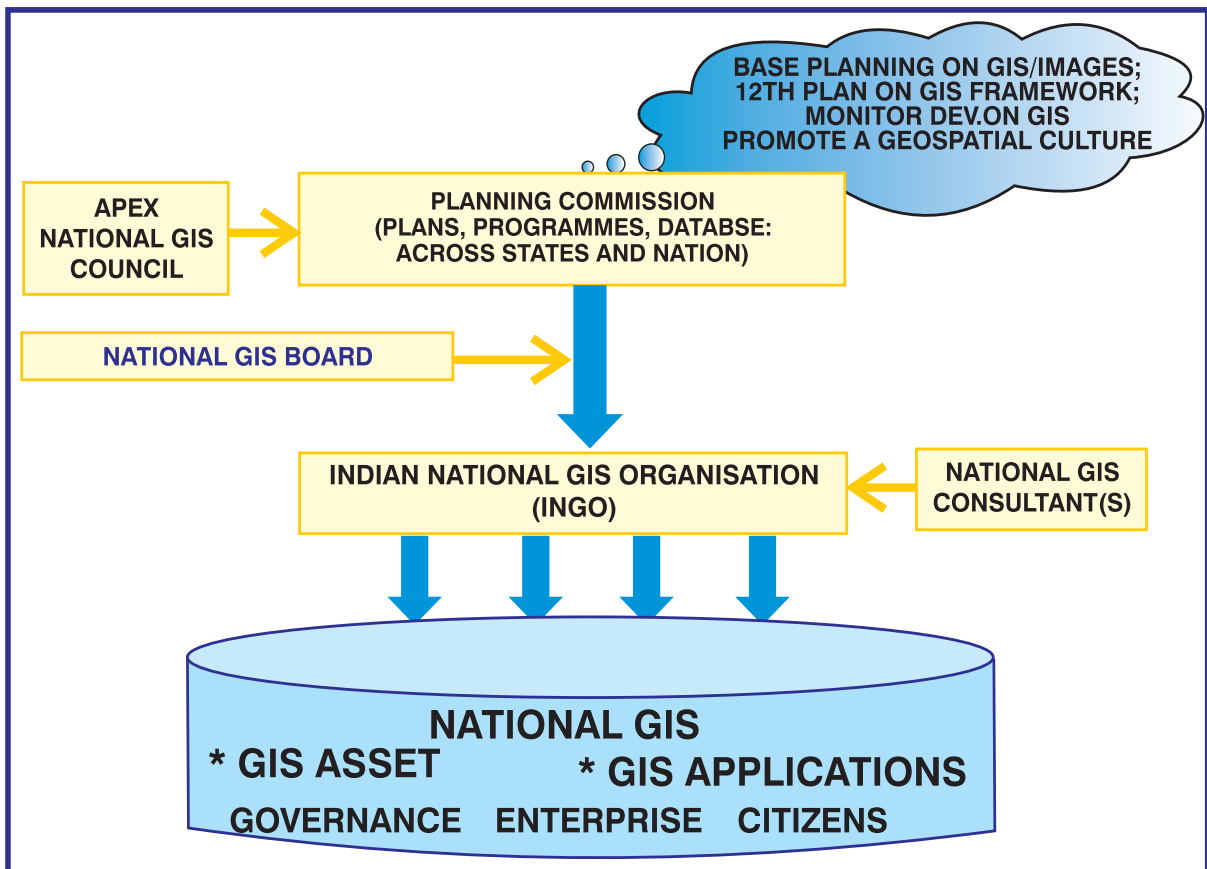
112. At the apex level, a National GIS Council (NGC) is proposed to be established and could be the key strategy body for guiding the activities of National GIS. The NGC could be chaired by (ICG Proposal: Hon'ble Prime Minister) with Deputy Chairman, Planning Commission as Co-Chair; Minister(s) of S&T/Planning; Adviser to PM on Public Information Infrastructure and Innovation; Cabinet Secretary and Member (Science), Planning Commission as Members.

113. At the operational level, a fully-empowered National GIS Board (NGB) could be the body for deciding, approving, overseeing and monitoring the activities of INGO and National GIS. The

NGB could be Chaired by Member (Science), Planning Commission and have all relevant Secretaries - DST, DOS, Agriculture, Rural Development, Urban Development, Health, Planning Commission, Home, Defence, Mines, Earth Sciences, IT and others; selected state representation (as required) and selected international/national GIS experts (as required and on case by case basis) and CEO of INGO as its Member-Secretary. The NGB is best as a fully empowered body that, under the Chairman, NGB, would guide, define procedures, approve, delegate and accord programmatic, procurement/contracting, hiring/recruiting, financial authorisations as appropriate for the overall activities of INGO and ensure that national needs of GIS are met by coordinating activities across different ministries/ departments and assimilating under INGO.

114. It would be essential to develop and position innovative methods of working where empowered committee systems determine the actions required and also ensure that defined procedures are followed – though the underlying factor would be the performance metrics of each such entity.

5.2.4. INGO's Human Resources

115. It is proposed to obtain the best GIS professional in the nation to head the INGO as its CEO. It is proposed to "search" for the best candidate within India for the CEO position. The selection would be based on a search-cum-selection process established by and supervised through the National GIS Board. The CEO would be responsible for implementation of National GIS as per plans approved by National GIS Board and would report to Chairman, National GIS Board.
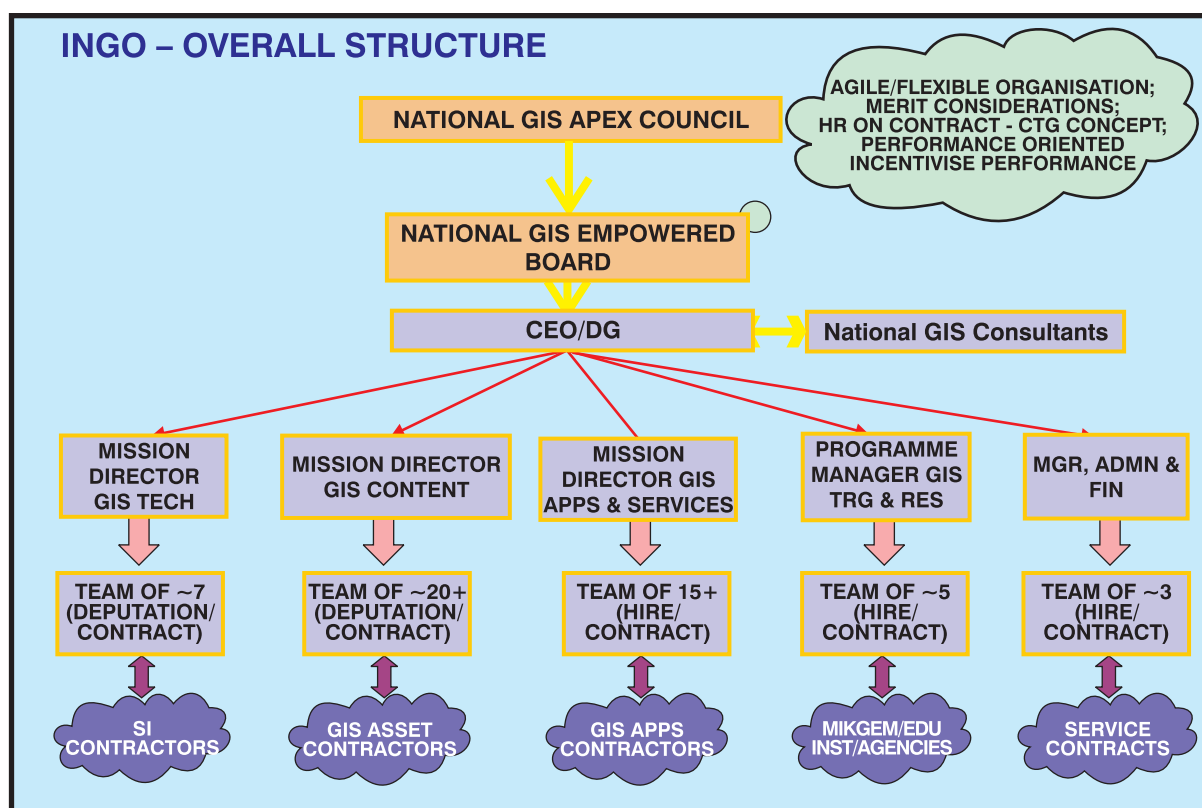
116. The CEO must be enabled for functional autonomy and responsibility of actions and performance and work towards the successful implementation of National GIS. Thus, it is essential to position the CEO with full administrative, technical, financial and functional authority to implement the activities and it would be necessary to position the CEO equivalent to Secretary, Government of India.

117. Presently, a set of ~50 persons could be contracted/recruited on term-basis as experts from government/private sector agencies, with best practices, could be drafted as Project Staff for the National GIS and INGO activities. As agility warrants, INGO could make regular annual assessment of staff and on approval of National GIS Board, additional required staff could be contracted/recruited. Much of the work could be contracted through well designed RFPs to industry for implementation. High calibre professional Consultants could be engaged to serve specific technical needs of INGO.

5.2.5. Performance Metrics definition for National GIS and INGO

118. It is essential to adopt modern practices to drive the performance of National GIS and INGO – such as a 360o evaluation of performance, based on a set of metrics/KPIs for measuring performance. At a broad level, the relevant metrics/KPIs for performance are tabulated in **TABLE - 6.**

119. The purpose of these Performance metrics is to incentivise efficiency and effective functioning of the organisation vis-a-vis the objectives, provide communications to the higher level authorities and stakeholders periodically on performance aspects, to enable any mid course corrections required, to provide learning value to the management and to enable future re-scoping/re-shaping and revitalising of the organisation. The metrics will essentially address the performance with respect to targeted achievements, technical outputs of the system with respect the specified plans approved by the board and also secondary parameters of schedule/budget etc. Further, the metrics will also address assessments of benefits, quality control, risk management and stakeholder satisfaction. A set of documents will be generated and approved by the Board that specify all the performance indicators (both at organisational and individual levels), methodology and the measurement/reporting frequency.

5.2.6. Linkage of INGO with States, Private sector, NGOSs, Academia

120. Right from beginning, it is envisaged that the success of INGO would be possible only if states/local bodies are also involved – as ultimately the management actions have to be implemented by the states/local level. Thus, INGO could encourage states, through suitable State RS Centres, to participate in establishment of National GIS and also to set up State/Local GIS and add-on GIS databases for governance/development of states.

121. INGO must be founded with a strong industry linkage and must establish National GIS and INGO activities through manageable projects through private sector participation. Indian GIS

industries have been consulted and it is seen that considerable capacity exists in private sector to service National GIS needs. Industries have been offering GIS services to various agencies and have considerable expertise in human resources at different levels. Thus, in the National GIS initiative, Indian GIS industries would have an important opportunity – not just for hardware/software supply BUT mainly in implementation and services, such as offering enterprise services of GIS data and GIS Applications, including complying private sector GIS data on the platform etc.
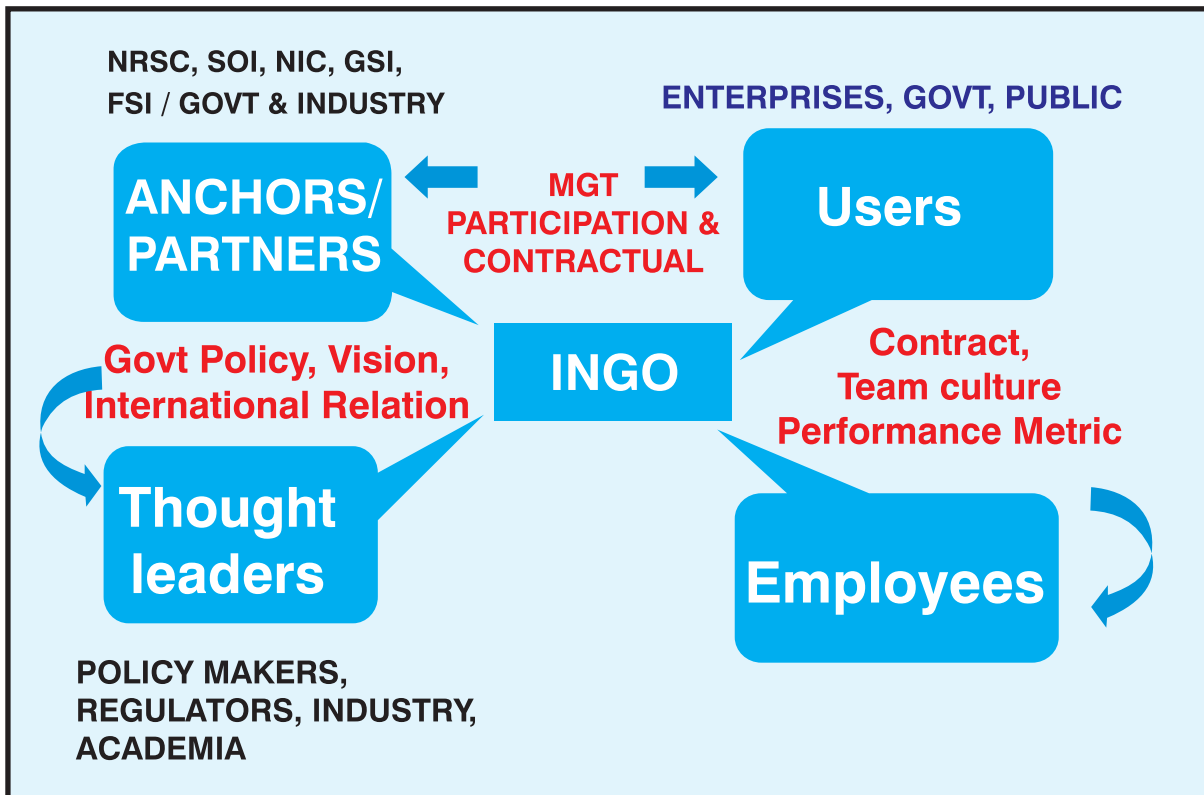
122. INGO would also link with academia to further specific research in the GIS domain that will make National GIS more productive and more widely used. Research in areas of GIS Policies, GIS Applications, Social relevance and assessments, local-area needs, technology impact, INGO structure effectiveness and other areas would be looked into. Results of research would feed into constant improvements in National GIS system.

6. STANDARDS, SPATIAL FRAMEWORKS AND BEST-PRACTICES

123. Standardisation and Process definition would be key for the success of National GIS and the scope of National GIS Standards and Processes needs to be all encompassing. In the context of National GIS, a STANDARD is a specific statement/document of the definitions, parameters and values, schema and any other constraints governing the naming, contents, quality of content, operations of software and hardware, service definitions etc for National GIS and a PROCESS is a set of sequential steps and actions that would define an activity.

124. The National GIS would, in fact, have a suite of national Standards – broadly two categories of Standards, namely:

   124.1 Basic GIS Standards for National GIS and its activities - defining the content and its characteristics of National GIS Asset; GIS database standards for the National GIS database, GIS Quality Standards – defining quality parameters and ranges for compliance to National GIS; GIS Metadata Standards – defining the Metadata for the National GIS Asset; GIS Compliance Standards for data ingest into to National GIS; GIS Application Service Standards

   124.2. Service Level Integration Standards - the success of National GIS is also dependant on the integration GIS services to other national services, database and applications (like E-Governance; ERP, CRM etc) and thus the National GIS Standard must also be so designed that it can easily have a 2-way integration with other IT Services/ERP/CRM/ data systems that may be in use in India (especially in government departments).

125. Similarly, the National GIS Processes would be a suite of steps/actions that define the totality of a single activity. Processes could include the methods for Data and Applications Publishing; Building a GIS Feature database; Using the NSF and so on. The more clearly and detailed the processes are defined, the smoother would be the implementation.

126. The National GIS Standards must be founded on principles of "open standards" and be "inter-operable" across platforms and systems and be totally neutral to any technology (thus, not being tied with any particular GIS or System technology).

127. As a national system, the possibility of an integration (if the need arises and is warranted by government) of an appropriate sub-set of the National GIS to global systems is possible mainly meeting nation's commitments in multi-lateral and UN frameworks. It is important to consider this in advance at design stage. While at no time the full National GIS is expected to dove-tail into global systems, it would be prudent to plan and develop a separate dove-tailed GIS system of essential and necessary elements for the UN/multi-lateral integration, if at all required. Thus, such a system would be a sub-set derived from the National GIS and can be maintained separately by INGO.

128. The National GIS Standards must be compliant with international ISO TC211 standardisation efforts – especially as India is already committed to ISO/TC standardisation efforts through the Bureau of Indian Standards (ISO is a multi-lateral body for standardisation and India is represented by BIS). The BIS has already set up a link-committee for GIS Standards and this link-committee could be the basis for National GIS Standards being compliant with ISO/TC efforts. In the definition and maintenance of National GIS Standards, it would be appropriate that INGO and the BIS link-committee also regularly refer and interface with other on-going GIS Standardisation efforts (like studying what other nations are doing; GSDI, OGC, ICA, CEOS/GEO etc) – even recognising that these may have a "specific characteristic" but nonetheless could be useful to leverage and build on to the National GIS Standards.

129. The National GIS Standards documents must be made easily accessible to one-and-all and enable a seamless, updated and easy-to-understand GIS data is available in National GIS.

130. The Standardisation activities must adopt core "change management" processes to undertake any changes and modifications to the National GIS Standards – with rigorous testing and compliance and certification procedures INGO must ensure that there are contractual obligation on the part of participating vendors/developers to adhere to all relevant and applicable National GIS Standards.

131. Existing GIS Standards like NNRMS Standard of 2005, NSDI Metadata Standards of 2001/ 2009 and NSDI Exchange Standards of 2001; NUIS Standards of 2004 have been studied and can be easily updated/enhanced and integrated into National GIS Standards.

132. Standards and Processes are best defined and documented by INGO at the time of implementation – mainly because the implementing agency must anchor the standards and process definition and further with rapidly changing GIS technology the changes of time must be included in standards.

133. Thus, while a broad definition of Standards and Processes are envisioned, at the time of implementation, INGO could first define following standards and processes (apart from any others that may be required:

    133.1. National GIS Content Standard: This Standard would define the content standards for National GIS Asset – identifying what feature would form part of the National GIS and from where it would be sourced/generated. (**TABLE-5** lists tentatively some of the most critical content and their parameters).

    133.2. National Spatial Framework (NSF) definition with a core standard layer of India boundary (with states, districts and other major features) as a core Geospatial dataset with appropriate datum/projections defined – which can be made freely available and accessible for all GIS activities in the country. The NSF, initially is to be defined

equivalent to 1:50k SOI Open Series Maps (with the available geodetic framework) and also later for 1:10k National GIS Asset (as and when the next depth of geodetic framework is available) requirement.

133.2.1. While WGS-84 datum can be standardised, it is important that the geographic projection be adopted by National GIS. This would enable maintaining the "centrality" of projection measurements and metrics (of area, perimeter, shape etc) and at the same time enable delivery in any projection on the fly to the user. This would also enable the dove-tailing to the International Terrestrial Reference Frame (ITRF) globally (thereby positioning India geographically in correct position of the global frame).

133.3. National GIS Database Standard – defining the spatial database design parameters – these can be adapted from NNRMS, 2005 Standards. The schema and parameter details can be appropriately updated by INGO by also referring to other GIS Standards – GSDI, ISO-TC211, OGC etc.

133.4. National GIS Quality Standards – adapted from NNRMS, 2005 Standard. The schema and parameter details can be appropriately updated by INGO by also referring to other GIS Standards – GSDI, ISO-TC211, OGC etc.

133.5. National GIS Metadata Standard – adapted from NSDI, 2003/2008 Standard. The schema and parameter details can be appropriately updated by INGO by also referring to other GIS Standards – GSDI, ISO-TC211, OGC etc.

133.6. It would be important to have a National GIS Content Thesaurus – that defines the class-categories and enables a common understanding and also links the categories to the purpose and use of the classification system. This definition can be based on "Ontology" concept to capture relationships of features and knowledge of domain of interest (say, agriculture, rural development, urban development, e-governance etc). GIS ontology can be "Domain-Specific (expert's knowledge, vocabulary of same feature with multiple meaning etc.)", "Task Specific (for example site suitability for a particular crop may require data from multiple source)" or "Data Specific (based on purpose and scope of project, study area etc.)". Such Ontology based definitions would be useful

133.7. National GIS Applications and Services Standard: **TABLE – 7** shows some of the parameters for the GIS Applications and Services Standards.

133.8. National GIS Portal Security Standard. Some possible parameters for consideration are mentioned in **TABLE-7**.

134. INGO, at the time of implementation and based on design decisions, must also develop different GIS Process Documents that define the steps and methods for various activities, including:

    134.1. National GIS Process document on GIS Asset creation

    134.2. National GIS Process document on Ingest of External GIS Content

    134.3. National GIS Process document on GIS Asset maintenance

    134.4. National GIS Process document on GIS Apps services publishing

    134.5. National GIS Process document on GIS Access

    134.6. National GIS Performance measure Process

    134.7. National GIS Process document for Revision/Updation of Standards

    134.8. National GIS Infrastructure Access Protocols

    134.9. National GIS Infrastructure Security Protocols

    134.10. National GIS Data Providers License Agreement

    134.11. National GIS Service Level Agreements protocols

135. Considering the importance and criticality of the National GIS Standards and also noting the continuously evolving nature of the technology, it would be appropriate to have a **Expert Standing Committee for National GIS Standards** – consisting of technical experts in the nation. Such a formal national-level technical standing committee can be tasked to help INGO define, develop, review, update the National GIS Standards. INGO could also enable larger consultation on the Indian Standards by appropriately involving larger cross-section of users, other experts in the nation and even international experts, as required.

136. INGO needs to take all steps to promote, encourage and generate/organise these GIS Standards, NSF and GIS Process documents and also encourage for using these to be able to integrate into the common platform of the National GIS. All government/enterprise and other private agencies need to comply with these standards, and NSF so that practices within their own processes will be able to contribute to and benefit from National GIS.

7.   ROLE DEFINITION FOR NATIONAL GIS ACTIVITIES

137. National GIS is best seen as a public-private involvement to become a reality – with government having a key role and obtaining the expertise and support of Indian industry and academia and other relevant agencies. Further, National GIS and INGO would not "displace" any existing activity but would bring in the over-arching integration for this national endeavour.

138. INGO would be key in bringing about the operationalisation and success of National GIS – especially as there is no single agency that is responsible for GIS in the country (even as many agencies have some elements of a GIS well-organised). Thus, INGO has to be created, established and enabled to bring National GIS to success.

139. INGO must bring about "commitment" of Anchor Agency roles for some key expert agencies – say, SOI and/or ISRO/NNRMS for GIS Asset related activities; NIC for Infrastructure and GIS Apps related activities and so on. Anchor Agencies are critical as they have the expertise and human resources to undertake responsible coordination/supervision/QA/QC for specific elements. By leveraging the expertise of available agencies to Anchor specific activities, INGO would benefit technically and managerially and could afford to be be "slim and agile".

140. Indian industry would have a major role to play in terms of offering high-quality, success-oriented, committed and cost-effective services and work with Anchor Agencies under contractual obligations to INGO. Private sector can undertake bulk of task activities by taking up design and implementation activities.

141. Leading institutions of repute and knowledge-capacity could be brought in to undertake specialised performance assessment, policy reviews and provide forward-looking "think-tank" activities for National GIS.

142. Academia and training/education institutions (both in public and private sector) could be encouraged by INGO to undertake the capacity-building and research/training activities.

143. In all the above, "merit" and deep sense of national-contribution must drive the involvement/selection of any specific agencies – using most modern/transparent methods of selection.

144. At a broad level, role definition for different entities have been identified, as follows:

ACTIVITY	AGENCY	REMARKS
OVERALL RESPONSIBILITY	PLANNING COMMISSION (INGO)	MISSION-MODE ESTABLISHMENT
GUIDANCE/ STRATEGY	NATIONAL GIS – APEX COUNCIL (DCH/PM CHAIR)	INTEGRATING NNRMS – FOCUS OF NR MGMT USING NATIONAL GIS; NSDI – PORTAL GATEWAY OF NATIONAL GIS TO BE ADDRESSED
IMPLEMENTATION/ MONITORING	NATIONAL GIS BOARD (MEM SCIENCE CHAIR WITH ALL SEC AS MEMBERS)	
IMPLEMENTATION RESPONSIBILITY	INGO	ESTABLISHED UNDER PLANNING COMMISSION
TECHNICAL ARCHITECTURING, COORDINATION	INGO & ANCHOR AGENCY	UNDER INGO SPECIFIC COMMITTEES/CONSULTANTS
NATIONAL GIS ANCHOR AGENCIES	INGO THRU NIC, SOI, NRSC …	A LEAD AGENCY IDENTIFIED FOR INDIVIDUAL ELEMENTS; QA/QC CERTIFICATION
NATIONAL GIS PROJECT EXECUTION	INGO	TASK CONTRACTS AND ASSIGNMENTS TO APPROPRIATE PUBLIC/PRIVATE AGENCIES
NATIONAL GIS APPS	INGO AND MINISTRIES (MOWR FOR WATER-GIS; PLG COMM FOR PLAN-GIS AND SO ON)	DESIGN, DEVELOPMENT, OPERATIONS THRU TASK CONTRACTS TO APPROPRIATE PUBLIC/PRIVATE AGENCIES
POLICY STUDIES AND PERFORMANCE EVALUATION	INGO	STUDIES AND EVALUATIONS; INVOLVE KEY INSTITUTIONS

8. NATIONAL GIS AND INTEGRATING NSDI/NNRMS AND LINKAGES WITH GOVERNEMENT MINISTRIES

145. The Planning Commission initiative of NNRMS (established for use of RS images in 1981 and serviced by DOS) and DST initiative of NSDI (established in 2005 for a "collaborative" and shared model of data generating agencies to provide spatial data) have been on-going. Much progress has been made by these initiatives – especially in bringing about large-scale awareness and usage of RS, through specific project-orientation, and generating excellent quality standardisation procedures for Metadata and Exchange and definition of a 1:10k topographic mapping programme.

146. As far as NSDI is concerned, it has published Metadata and Exchange standardization documents (while work on Content, Apps etc is going-on), state-portals and agency-portals, policy initiatives etc,   it is to be noted that many key SDI related activities could not get fructified and some could be taken up only in a limited manner and that NSDI is in fact seen as merely a DST project. It is clear that NSDI has faced many challenges and thus many primary and essential goals SDI could not get achieved – though some good work on standardization has been done for Metadata and SOI-DVD Exchange (with others on-going) and inter-operability tests – apart from the annual Conferences. NSDI has also outlined its aspiration (in the NSDI Aspirations Document of August, 2011) where the importance and critical relevance of GIS DSS has been underscored. It is all the more important and essential to see that National GIS Vision does not face the same difficulties of achieving the primary goals of GIS DSS for governance, enterprises and citizens based on a nation-wide GIS Asset and thus must address the learnt gaps and position an institutional focus that will bring success and enable the GIS DSS for governance, enterprise and citizens.

147. Under the NNRMS framework, ISRO/DOS has implemented various user-requested/funded projects (ministries and departments) of RS-based thematic mapping and organizing project-specific GIS databases have been achieved (Wastelands-3 cycles; GW Prospects; Wetlands; Urban GIS for 102 cities; Biodiversity-3 cycles etc). Based on these, a Natural Resources Data Base (NRDB) is organized for these projects. NNRMS is also generating 7 layers of nation-wide seamless GIS content as part of NR Census – out of which 4 of these are updated/maintained (Landuse/Landcover, Glaciers/Snow, Wetlands, Vegetation). ISRO has also developed Portals – Bhuvan (for IRS images), Bhoosampada, WRIS etc NNRMS has also developed the NNRMS Standards of 2005 that cover most RS and GIS activities. It was noted that ISRO, under the NNRMS framework, would henceforth take up RS and GIS projects only at user (ministries/department) requests. NNRMS has created many project specific GIS and the 4 layers of NR Census would be most relevant for National GIS – these could be major

inputs for the National GIS Asset (especially the 4 layers of NR Census which is updated under NNRMS). The experience of NNRMS (NNRMS Standards, NRDB/ Bhuvan and other Portals etc) is valuable and must get integrated into National GIS.

148. National GIS is envisioned to be user-driven and focusing on DSS GIS Apps for governance/ enterprises/citizens. The National GIS aims to establish a national GIS-Platform for GIS DSS Applications – organized on a nationwide, seam-less, maintained GIS Asset which is much, much more that just maps and is ~40+ GIS-READY features and large amount of non-spatial (but geo-tagged) critical ministry/department/user tabular data in GIS-READY format. The National GIS would directly provide GIS services for ~24+ (as of now) ministries/departments – covering many governance areas.

149. It is ESSENTIAL AND IMPORTANT that National GIS and INGO collate the NNRMS and NSDI aspirations by properly linking/integrating and ensuring that no duplication of efforts happen – this will have to be very clearly worked out at time of implementation of National GIS. The National GIS must, in fact, fill the much needed gaps of bringing the National GIS Asset, developing GIS DSS Apps, National GIS Portal and the National GIS infrastructure – thereby, building over what has been achieved till now and a single-minded national focus for GIS activities are achieved – which is the utmost important need.

150. ICG suggests that any structural integration/dove-tailing of proposed National GIS structure and present NSDI structure is done at an appropriate level by Planning Commission. However, a possible scenario of the integration could be:

150.1. National GIS and NSDI (i) have a "dove-tailing" structural integration of present National Spatial Data Committee (NSDC) into National GIS Apex Council (Ministerial body) and National GIS Board (Secretarial level) and (ii) the present NSDI activities "dove-tailing" into National GIS with continuance of a National GIS Standards Committee (NSC) for definition of Standards and test-beds definition/implementation etc (that NSDI is presently undertaking) getting harmonised.

150.2. NNRMS continuing its drive of the usage of RS images for various thematic applications and generating user-specified, project-specific thematic GIS databases – especially related to content already available but also for the 4 NR Census layers. These could appropriately form part and parcel of National GIS Asset after compliance to standards and as per practice to be adopted.

151. INGO must build and develop close linkages with each user ministry to support organising respective ministry-specific GIS data needs; linking to National GIS and also developing applications for user Ministries. INGO would also address the training needs and provide all technical anchoring/procurement for any GIS support to users.

152. INGO must also develop linkages/mechanisms with map/data generating agencies by which map/data can be sourced from these agencies and processed for GIS readiness and then included in National GIS, as per compliance with National GIS Standards.

153. Higher-level discussions are further required for these linkages/integration and, if required, re-scoping/re-definition/re-tasking can be worked out to avoid any redundancy and duplication of efforts.

9. FUNDING PRINCIPLES FOR NATIONAL GIS

154. In an initial and tentative estimate, the National GIS and INGO establishment would have to be supported over a 3-years period and, subsequently, an annual recurring expense for INGO (and maintenance of National GIS Asset and National GIS Apps) also need to be covered.

155. It is envisaged that Government funding for the establishment of the National GIS is a must – especially as it is the founding responsibility to establish the basic GIS infrastructure that helps the nation, as a whole. This first step of the Government will bring confidence for proper development and usage of GIS technology and its benefits and also for any subsequent private investment model for this activity – just as it happened in any other sector (telecom, roads, aviation, railways etc – in most of these sectors the business sector grew only when the founding investments for the infrastructure had already been made by government and provided the "platform" and standardisation for a business model to develop).

156. Thus, the funds for establishing National GIS and INGO would have to be committed by government. A business model will become viable when the basic GIS infrastructure is established and it will be possible to attract private sector investment for the following activities:

   156.1. **Revenue from licensed-sale of GIS Asset data and GIS Applications:** National GIS must generate revenue by the licensed-sale of the GIS Asset data and licensed-access of GIS Applications from appropriate categories of users.

   156.2. **License to Update National GIS Asset and develop Applications as a service:** It is planned that the updation and maintaining the National GIS should be able to finance itself and operate on its own fund generation. It would be possible to obtain private investments from Indian private sector for "licensed operation of National GIS tasks" on a license fee model for maintaining/updating the National GIS Asset and building a wider GIS application commerce. Pan-India or Regional licensing for multiple private sector agencies to further maintain the GIS Asset and market the data and its applications to market needs of government, enterprises and citizens could be adopted (on similar lines of telecom sector).

   156.3. **Building GIS Applications Service** through B2B and B2C applications. Private investment in GIS Applications service could increase tremendously. GIS Applications can expand into many newer governance, enterprise areas with pay-per-use or fixed cost models built-in for the service.

10. SCHEDULE

157. The Implementation of the INGO and National GIS could be carried out in 3 major phases:

   157.1. Preparatory Phase (through this ICG) (2-3 months for Visioning, design, standards characterization and approvals): Vision Task, wherein the intent will be to prepare a Blue-Print for the National GIS platform and allow for a smooth implementation. This activity would be completed by the Interim Core Group.

   157.2. There would be a period of 1-2 months for necessary government approvals and the formal establishment of INGO (and positioning of CEO and a minimal level team to start with) – which can then start the National GIS activities. This is the start time "T" for all subsequent activities.

   157.3. National GIS Version 1.0 and INGO (about 6-9 months from "T"): Starting with the establishment of INGO, implementation of the Pilot stage of National GIS by organizing National GIS Asset Version 1.0 using 1:50K NSF and available SOI 1:50K base with add-on of available thematic maps, sourced datasets from government/ private agencies; develop and position key National GIS Applications (for few ministries - Plan-GIS for Planning Commission; GIS for Public Services and Rural-GIS for Ministry of Rural Development and others); establishment of National GIS Portal; access to private enterprise and citizen access; implementing 2 National GIS dashboard for PMO and Planning Commission; initiate GIS Capacity-building activities and position National GIS Policy.

      157.3.1. As there is interest from private sector agencies to offer their case GIS applications during Version 1.0, this maybe examined while implementation by INGO. Such an exercise could have logistical difficulties but this could be examined and assessed and if feasible implemented.

   157.4. National GIS Version 2.0 (about 36 months from "T"): Building upon National GIS Version 1.0 by translating to 1:10k NSF (which has to be freshly done); establishing 1:10k National GIS Asset for whole country; develop and position full-scale National GIS Apps for governance, full-scale access to private GIS Apps and also National GIS Apps for citizen access; continue GIS Capacity-building activities; INGO to continuously service GIS needs of government agencies

158. Subsequent to this, the updation/maintenance cycle of National GIS Asset layers on a yearly basis (or determined cyclic basis) and further support for National GIS Applications would have to be taken up.

REFERENCES/DISCUSSIONS

In preparing the initial documents, the ICG has founded its envisioning on the initial Planning Commission's Background Document for the National GIS. ICG has referred to a variety of Indian and international documentation on GIS and its applications – some of these have been also very useful in designing the concept and plan for National GIS.

ICG has also referred to a host of internal programmatic assessments and internal documentation that have given insights to how some of the past programmes have evolved and these have been useful in addressing any gap and further evolve the concept of National GIS. Of particular references are those that have been generated by GSDI, Indian NSDI, NNRMS, reports by NIC, GSI, FSI, ESRI reports and inputs from other private sources and media. These have all helped in a proper understanding of the issues related to GIS.

Of great help and value have been extensive and intensive inputs provided through a series of discussions by the Members of the Planning Commission - specifically valuable inputs have been obtained from Mr Montek Singh Ahluwalia, Mr Arun Maira, Mr BK Chaturvedi, Dr Saumitra Chaudhury and Ms Sudha Pillai. The visioning exercise has also got considerable inputs and suggestions from Mr Sam Pitroda, Adviser to PM on PII and Innovation; Mr Nandan Nilekani, Chairman, UIADAI; Mr PK Basu, Secretary (A&C) DAC; Mr T Chatterjee, Secretary (MoEF); Mr Dhruv Vijay Singh, Secretary (MoWR); Mr Navin Kumar, Secretary (MUD); Dr T Ramasami, Secretary (DST); Dr Samir Brahmachari, Secretary (DSIR) and Dr BK Gairola, DG-NIC. Other eminent persons who provided insights included Mr Kiran Karnik and Mr Som Mittal, the past and present Presidents of NASSCOM.

The intensive consultations with the Government Users sub-group (which had ~35+ government agencies/departments); Indian GIS Industry sub-group (having ~38+ GIS industry representatives); academia and NGOs (having about 14 academia/NGO representatives) associated in GIS have been extremely valuable and has enabled broad-basing of consultation and opportunity of inputs from the best GIS professionals in the country. ICG obtained specific GIS DSS requirement definitions from almost 19+ ministries/departments - these consultations have helped ICG with the inputs for defining the GIS DSS of National GIS and also key inputs for its implementation.

A large number of officials from Survey of India; NSDI Secretariat; National Innovation Council; many executives of industries have also provided valuable inputs. ICG has also keep a track of discussions on National GIS in GIS publications – Coordinates; Geospatial Today; GIS Development and even in media (Economic Times; blogs and sites etc) and has taken many appropriate and valuable inputs from these.

In a Workshop held on September 14, 2011, a final round of consultation and discussion was held on National GIS Vision and important feedback/inputs were obtained and incorporated. Thus, the Vision now is inclusive of a broad-based wide consultation amongst government, enterprises, academia and NGOs.

The secretarial and administrative staff of Ministry of Earth Sciences and office of Member (Science), Planning Commission deserve special mention – they supported and made possible the large amount of documentation/materials that have been organised.

The ICG feels, that as a national endeavour, the envisioning exercise has enriched the internal national capability in GIS .... **Today, India is much more ready and prepared to implement National GIS.**

TABLE-1: A BRIEF OVERVIEW OF GIS ACTIVITIES IN INDIA

No	GIS ACTIVITY	BRIEF OVERVIEW
1	Survey of India topographic maps (SOI)	SOI topographic maps in digital sheet-format as Open Series Maps are available for whole country on 1:50k scale and for considerable areas on 1:25k scale. These are high-quality cartographic maps.
2	India NSDI Portal (www.nsdiindia.gov.in) (DST)	India's NSDI is an enabling mechanism for GIS standardization and also for generating testbeds for inter-operability. However, NSDI does not have a DSS based on spatial data, the need for which has been recognized.
3	NNRMS (www.nnrms.gov.in) (Planning Commission and ISRO/DOS)	NNRMS has focus for natural resources management and is undertaking specific projects for natural resources mapping using remotes sensing images on request by Ministries/Departments - wastelands, landuse, vegetation/biodiversity, wetlands, glaciers etc. These maps are available with respective Ministries/Departments.
4	NRDMS (DST)	Develop computer compatible methodology for developing spatial databases on natural resources, socio and agro-economic parameters to further the concept of area specific decentralized and micro-level planning and promote R&D in spatial data management.
5	NIC Map Portal (https://gisserver1.nic.in/india1/) (NIC)	Leveraging framework E-Governance & planning services in government upto district level and set-up Service Oriented Architecture for Multi Layer GIS services integrating spatial as well as non-spatial data from various organizations including National Mapping Agencies as well as Ministries/Departments.
6	NUIS (MUD)	Develop GIS databases for 152 towns/cities in the country in two scales i.e., 1:10,000 and 1:2000. The spatial and attribute databases thus generated will be useful for preparation of Master/Development plans, detailed town planning schemes and serve as decision support for e-governance.

No	GIS ACTIVITY	BRIEF OVERVIEW
7	Bhuvan (www.bhuvan.com) (NRSC/DOS)	Bhuvan is the IRS image visualisation for India through a image-portal easy visualisation to information on basic natural resources and various thematic data generated from different national thematic mapping missions and projects.
8	GSI Portal (http://www.portal.gsi.gov.in/) (GSI)	Geological Survey of India has generated voluminous amount of geo-scientific data through field surveys and laboratory studies. GSI disseminates these information in the form of maps, publications and unpublished reports. The GSI Portal provides access to these.
9	MapMyIndia Portal (www.mapmyindia.com) (MapMyIndia)	MapMyIndia has GIS data asset and applications services that are useful for navigation and location-based services and business geographics. MapMyIndia (and similar other private ventures) also have nation-wide seamless GIS-ready assets.
10	Soil Maps (NBSSLUP)	Soil maps of India are available at association series level from NBSSLUP as part of the National Soil Registry.
11	Census Maps (http://www.censusindia.net/) (RGI)	Census Maps are available where maps of census data are visualised.
12	Gujarat State (thru Bhaskaracharya Institute of Space Applications and Geomatics – BISAG)	Gujarat has established and is maintaining a comprehensive state-wide GIS asset and has developed a variety of GIS applications for various departments (rural development, urban management, disaster management, amenities planning, MNREGA programme monitoring and many others). It is supporting the government with an active GIS solution in such a way that most governance activities are now on a GIS base.
13	Maharashtra (through Maharashtra State Remote Sensing Applications Centre – MRSAC)	Maharashtra has also developed and maintaining a state-wide GIS asset that is supporting many planning and development activities. The state has developed many GIS applications of relevance for rural development, irrigation department, roads and infrastructure and many others.

No	GIS ACTIVITY	BRIEF OVERVIEW
14	Andhra Pradesh (through AP State Remote Sensing Applications Centre – APSRAC)	AP state has also established a state-wide GIS database that is supporting the government departments. The Centre has developed many GIS applications that serve many departments.
15	Haryana (through Haryana State Remote Sensing Applications Centre)	Haryana also has a state-wide GIS database and a large number of applications of relevance for rural development, irrigation, amenities, land resources etc
16	Kerala (thru Kerala State Science and Technology Council)	Kerala has mapped at panchayat level and is presently organising a Kerala State SDI with support from DST.
17	Karnataka (thru Karnataka State Science and Technology Council and Karnataka State Remote Sensing Centre)	Karnataka has a state-wide GIS database and many applications that have been developed for state and district administration. Karnataka is establishing a SDI with support from DST.
18	Jharkhand (thru Jharkhand Remote Sensing Centre)	Jharkhand has established a GIS database for whole state of Jharkhand and the same is now available as a e-governance initiative on Jharkhand GIS portal

Note: The above listing is a sampling of agencies that have significant and comprehensive GIS related activities and are mentioned here to more illustrate the national capabilities. There are many central/state agencies that have considerable GIS activities through projects, applications etc.

TABLE-2: STATE-OF-ART GIS ACTIVITIES IN THE GLOBAL ARENA

No	Country	Status of GIS
1	USA	USA established a seamless geospatial Data Portal as a standardized process with GIS for the Nation – which means GIS for the neighborhood, town, state, and country. The goal is to build an interoperable system of systems that leverages standards and best practices. The emphasis is on local data needs and local practices, along with data integration at State Regional, and ultimately National levels. Through the Geospatial OneStop USA organizes and provides a host of GIS datasets and application services. (http://gos2.geodata.gov/wps/portal/gos) In recent times, US has also started discussion on a National GIS and is still considering this concept – though the concept of a national GIS dataset is already pervading.
2	China	China, in 2009, has established a nation-wide GIS Plan as a government initiative and has initiated steps for organizing a nation-wide GIS layers and access system under China's Development and Reforms Commission.
3	UK	UK has established a nation-wide MasterMap GIS with involvement of private mapping/survey agencies and enables public access to maps and geospatial data on specific access and cost terms.
4	Indonesia	Indonesia has just announced a National GIS Data project under a Presidential Decree and is using commercial players to establish the Indonesian GIS system.
5	Brazil	Brazil is also designing/working out a Brazilian National GIS Development System under the Ministry of Development and Economics.
6	Singapore	Singapore has made a full-scale GIS of Singapore and is available on web access and also serves the needs of all departments and citizens.
7	UAE (Abu-Dhabi)	The AD-SDI Geospatial Portal, under the E-Governance initiative, provides a single point of access for geospatial information across the entire UAE community. The portal hosts a wide range of data and information as well as providing map services and will serve the needs of government and citizens access as per conditions and terms. (Ref: http://geoportal.abudhabi.ae/geoportal/)
8	European Nations	Infrastructure for Spatial Information in the European Community (INSPIRE) is an EU initiative and a geoportal to provide the means to search for spatial data sets and spatial data services, and subject to access restrictions, view and download spatial data sets from the EU Member States within the framework (Ref: http://www.inspire-geoportal.eu/)

No	Country	Status of GIS
9	The Netherlands	The Geospatial Data Service Centre (GDSC) is a common initiative of the National Aerospace Laboratory NLR and the Geomatics Business Park and aims to delivers to the users integrated spatial information services. Presently, it provides an access point to earth observation data in the Netherlands to aerial photography, high resolution satellite imagery and satellite navigation data. The GDSC fits in the "Infrastructure for Spatial Information in the European Community (INSPIRE)" imitative. (Ref: http://gdsc.nlr.nl/gdsc/en)
9	Australia	Australia has established a GIS Platform for Australia consisting of maps and images and pockets of land records data.
10	Russia	Russia has established a seamless, nation-wide land cadastre GIS Portal that allows land cadastre services offered on the network. (www.maps.rosreestr.ru/portal)
11	Iran	The National Geoscience Database of Iran (Ref: http://www.ngdir.net/AboutUs/AboutUs.asp) opens its way through the collection, systematization and organization of geoscience data in an easy and instant way to supply needs of managers, administrators, domestic and foreign investors and industrial, economical and political sectors.

TABLE-3: BROAD DETAILS OF NATIONAL GIS INFRASTRUCTURE

The GIS Infrastructure could have following elements:

- Web-Servers bank allowing a single gate-way to National GIS Portal
- Data Servers bank and Network Storage systems to host and maintain the National GIS Asset
- Security Servers with state of the art security technology deployment (Firewall, Intrusion Prevention System, Gateway Anti-virus Solution, Proxy Server, URL Blocking etc)
- Payment gateway Servers that manage payments and financial transactions via banking services for National GIS Asset and Application access operations that may require financial transactions.
- Disaster Recovery and Business Continuity servers for the total system
- Various software - operations systems, cloud-based Database engines, cloud-based GIS Servers, customised GIS Applications software and others
- Application Servers that can be "configured" in architecture to establish a National GIS DSS services
- A configurable GIS DSS Applications framework would be required on the GIS infrastructure that allows customizing, publishing and access to a variety of customised GIS applications.
- National GIS based on the latest Service Oriented Architecture (SOA) technology. SOA is an architectural and design protocol conceived to achieve the goals of increased interoperability, increased federation (uniting resources & applications while maintaining their individual autonomy & self governance) and increased business & technology domain alignment.
- Easily customizable GIS Apps - Pluggable apps-services architecture for customizing/creating new web-Based GIS-DSS Applications that do not require user-end large investments in software/hardware/database technology.
- Infrastructure, Software, Solutions as a service concept where the basic concept should be to access GIS DATA and GIS APPS – with no user-end requirements. This would minimise user-level investments of costs/time/efforts AND maximise value and applications.

(Design and Architecture to be worked out in detail by INGO)

TABLE-4: LIST OF NATIONAL GIS ASSET CONTENT

(SCALE NOT RELEVANT IN GIS: INFORMATION CONTENT EQUIVALENT TO SCALE 1:10,000-FOR USER-REFERENCE: ABSTRACTION FROM LARGER SCALES AND GENERALISATION TO SMALLER SCALES, AS REQUIRED;)

NO	CONTENT LAYER	DESCRIPTION	POSSIBLE PRIMARY SOURCE (VINTAGE)	POSSIBLE ALTERNATE SOURCES	POST-2011 UPDATE PROCESS	LINK FOR TABULAR DATA	ATTRIBUTES ASSOCIATABLE (SOURCE)
A]	NATIONAL GIS FOUNDATION DATASET (OPEN AND FREE ACCESS)						
1.	1:50K Framework (2005): Administrative boundaries - 2011 (National, State, District, Sub-district, Taluka/Block/ Panchayat, Village)	A basic Foundation Dataset Ver1.0 and freely available and accessible spatial content which is adapted from SOI maps on 1:50K and with appropriate geodetic framework.	SOI & Census department on Census-Code	None	By SOI/INGO as and when new districts/states changes happen	Names of States, Districts, sub-districts, Taluka and villages	Census data tables (2011) and also past Census tables (RGC)
2.	1:10K Framework (Future): Administrative boundaries – 2011 (National, State, District, Sub-district, Taluka/ Block/Panchayat, Village)	An updated basic Foundation Ver 2.0 dataset and freely available and accessible spatial content which is adapted from SOI maps on 1:50K and with appropriate geodetic framework.	SOI & Census department on Census-Code	None	INGO has to take this up with SOI for 1:10k geodetic framework. By SOI/INGO as and when new districts/states changes happen	Names of States, Districts, sub-districts, Taluka and villages	Census data tables (2011) and also past Census tables (RGC)

NO	CONTENT LAYER	DESCRIPTION	POSSIBLE PRIMARY SOURCE (VINTAGE)	POSSIBLE ALTERNATE SOURCES	POST-2011 UPDATE PROCESS	LINK FOR TABULAR DATA	ATTRIBUTES ASSOCIATABLE (SOURCE)
B]	**BOUNDARY CONTENT**						
3	Census EB	Boundaries of Census Enumeration Blocks	Census department on Census-EB Code	None	INGO has to link with Census to ensure real-time updation of EB as and when it happens	EB Code	Census data; Ministry developmental data etc
4.	Watershed and Command area boundaries	Boundaries of Watersheds - upto Micro-watershed level	SLUSI (2008)	None	–	Watershed Codes	Watershed-level data of MoRD
5.	Forest boundaries	Forest boundaries of Range, Sub-range, compartments etc	State Forest Dept OR FSI (2010)	None	Annual Update Cycle: INGO with FSI to Review changes every year	Forest Range-level codes	Forest level data of MoEnF
C]	**CULTURAL FEATURES**						
6.	Rail lines	From SOI Maps/Railway Maps/ Satellite Images	Railways/SOI (2005)	Fresh Mapping using Images and surveying	Annual Update Cycle: INGO in consultation with MOR and also as and when changes happen	Rail-line attributes from MOR	Rail data of MOR

NO	CONTENT LAYER	DESCRIPTION	POSSIBLE PRIMARY SOURCE (VINTAGE)	POSSIBLE ALTERNATE SOURCES	POST-2011 UPDATE PROCESS	LINK FOR TABULAR DATA	ATTRIBUTES ASSOCIATABLE (SOURCE)
7.	Roads	All roads (EW/NH/SH/DR/ODR/ VR/FWR/Tracks) with attributes	SOI/NHAI/ NRRDA/SRRDA (2005-2010)	Fresh Mapping using Images and surveying	Annual Update Cycle: By INGO in consultation with NHAI as and when changes happen	Road attributes	Roads data of NHAI.MOST
D] HYDROLOGY CONTENT							
8.	Surface water bodies	All surface water bodies with attributes	SOI/MoWR-Hydrology Project (2009)	Fresh Mapping using Images	Annual Update Cycle: To be used on annual basis by INGO with MoWR	–	Surface water body data from MoWR
9.	Drainage	Rivers, Streams, Canals, others from satellite images and also from SOI maps	SOI Maps, SLUSI Maps (2005)	Fresh Mapping using Images	–	Drainage-type/level	–
10.	Canals	All Canal systems	SOI/MoWR Hydrology Project (2009)	Fresh Mapping using Images	Annual Update Cycle: To be updated on annual basis by INGO with MoWR	Canal Index	Canal-level data from MoWR
11.	Ground water prospects – 50k (2005-2008)	Groundwater Prospect Maps	Rural Dev Ministry thru NNRMS	Fresh Mapping using Images	Update Cycle: TBI; INGO with MoRD to finalise	–	GW data from MoWR

NO	CONTENT LAYER	DESCRIPTION	POSSIBLE PRIMARY SOURCE (VINTAGE)	POSSIBLE ALTERNATE SOURCES	POST-2011 UPDATE PROCESS	LINK FOR TABULAR DATA	ATTRIBUTES ASSOCIATABLE (SOURCE)
12.	Groundwater Well Locations	Well locations and their attributes	MOWR	States/WRIS	MOWR	Well-Id	Well attributes data of depth, water quality etc
E]	**URBAN AND SETTLEMENT CONTENT**						
13.	Settlement Points	Village settlements as points from Census	Census	None	Annual Update Cycle: Updation as and when changes happen	Settlement name	Census data of 2011
14.	Built-up Map	Settlement or built-up polygons of built-up areas on a yearly basis	SOI (2005)	Fresh Mapping using Images	Annual Update Cycle: INGO with MUD	Urban area name	Urban data of cities from MUD
15.	Urban Landuse as per NUIS	Urban area landuse maps as per NUIS for all cities landuse/building-level information	MUD (~150 cities) (2006)	Fresh mapping from Satellite Images	2-yearly update cycle: INGO with MUD (also to expand for all cities)	Urban Landuse Category	Plans/schemes data of MUD
16.	Hamlet Points	Pints of hamlets in villages	SOI (2005)	States; Fresh Survey	On a cyclic basis every year	Hamlet Code	Hamlet details of RD, Panchayat and other details.
F]	**ENVIRONMENTAL CONTENT**						
17.	Biodiversity/Vegetation richness - 250k	Vegetation richness and biodiversity maps	DBT/NNRMS	Satellite Images	Update cycle	Codes	–
18.	Wetlands	Wetland maps available at 50k	MoEnF/NNRMS	Satellite Images	Update Cycle 5 years	Wetland Name and code	Wetland data from MoEnF
19.	Forest Vegetation	Forest types and Densities maps of FSI	FSI	–	Update every 2 years	Codes	Forest type and Desity details of MoEnF

NO	CONTENT LAYER	DESCRIPTION	POSSIBLE PRIMARY SOURCE (VINTAGE)	POSSIBLE ALTERNATE SOURCES	POST-2011 UPDATE PROCESS	LINK FOR TABULAR DATA	ATTRIBUTES ASSOCIATABLE (SOURCE)
20.	Coastal wetland	Coastal Wetlands	MoEnF/ NNRMS (2005)	Fresh mapping from Satellite Images	2-yearly cycle: INGO with MoEnF	Codes	–
21.	Glaciers	All Glaciers maps	MoEnF/ NNRMS (2009)	Fresh mapping from Satellite Images	2-yearly cycle: INGO with MoEnF	Codes	–
22.	Pollution Measurement Points	All point locations where pollution data is collected	CPCB	Fresh GPS based point survey	Annual Update Cycle: INGO with CPCB	Pollution Station Ref	Average daily/ weekly Pollution data of Air, water etc
GJ	GEOLOGICAL CONTENT						
23.	Geomorphology	Geomorphology information	GSI (50k available)	–	One-time	–	–
24.	Lithology	Lithological information	GSI (50k available)	–	One-time	–	–
25.	Structures	Structures information	GSI (50k available)	–	One-time	–	–
26.	Mine Locations	Locations of Mines as per GSI/MOM data	MOM/GSI	–	As and when changes happen – atleast once a year	Linkage to attributes on specific basis with MOM/GSI database for in-house MOM/GSI Apps	Limited to Mine Metadata for National GIS; mine details specific to MOM/GSI apps.

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NO	CONTENT LAYER	DESCRIPTION	POSSIBLE PRIMARY SOURCE (VINTAGE)	POSSIBLE ALTERNATE SOURCES	POST-2011 UPDATE PROCESS	LINK FOR TABULAR DATA	ATTRIBUTES ASSOCIATABLE (SOURCE)
H]	LANDCOVER/LANDUSE CONTENT						
27.	Wastelands	Wasteland information	MoRD/NNRMS (2009)	Satellite Images	Monitoring Cycle		
28.	Landuse /landcover - 50K	Landuse/Landcover information on 50K	NRSC (2010)	Satellite Images	Update cycle every 2 years; Upscope to 1:10k: INGO to work out with NRSC		
29.	Landuse/Landcover - 10K	Landuse/Landcover information on 10K	–	Satellite Images	INGO to work out details		
I]	LAND OWNERSHIP INFORMATION						
30.	Land Ownership (as available)	Land ownership level maps adjusted into National Frame	States/NRLMP	–	INGO to work out details for this.	Ownership Number	Ownership details from DLR
J]	TERRAIN INFORMATION						
31.	Slopes	Slopes derived from 20m contours of SOI maps or from Cartosat-1 DEM	SOI Maps	Cartosat Images	–	Slop codes	–
32.	DEM	DEM from SOI 20m Contours or Cartosat-1	SOI	Cartosat-1 DEM	–	DEM value	–

NO	CONTENT LAYER	DESCRIPTION	POSSIBLE PRIMARY SOURCE (VINTAGE)	POSSIBLE ALTERNATE SOURCES	POST-2011 UPDATE PROCESS	LINK FOR TABULAR DATA	ATTRIBUTES ASSOCIATABLE (SOURCE)
K]	SOILS INFROMATION						
33.	Soils	Soil association/series level information from NBSSLUP at level available	NBSSLUP	–		Soil association/ Series code	Soil texture, depth, fertility details from NBSSLUP
34.	Land Degradation	Degraded lands maps and attributes	SLUSI	–	Update every 5 years by INGO with SLUSI	Code	Land Degradation details from SLUSI
L]	SATELLITE IMAGES						
35.	Satellite Images of 55m (every half-yearly), 23m (base-2-years) and 5.8m XS and 2.5m (every 2-5 years) and 1m (localized areas images)	Images from NRSC as per RSDP	NRSC	–	Annual Updates as per Review cycle	–	–
M]	AMENITIES						
36.	Amenities	Specific data of points of interest – schools/ edu facilities, hospital/ health facilities, banks, seed centres, markets, tourism sites etc from GPS Survey	–	From GPS Survey contracts by INGO	INGO to work out update cycle- atleast every 2 years	Point Category and Code	Details of Amenities- schools/edu facilities (from MHRD), hospital/ health facilities (MOH), rural banks (NABARD),

NO	CONTENT LAYER	DESCRIPTION	POSSIBLE PRIMARY SOURCE (VINTAGE)	POSSIBLE ALTERNATE SOURCES	POST-2011 UPDATE PROCESS	LINK FOR TABULAR DATA	ATTRIBUTES ASSOCIATABLE (SOURCE)
							seed centres (MOA), markets (MOA), tourism sites (MOT)
37.	Utilities	Power, Gas, Telecom	-	To be compiled from GAIL, DOT, et	Annual Review Cycle by INGO	Utility codes	Details of Utilities from GAIL/DOT etc
N]	MET AND CLIMATE DATA						
38.	Met Data Collection points	GPS Location of points associated to average daily met data – temp, rainfall, humidity	MoES	-	Regular update	Met Point Code	Average daily/ weekly temp, rainfall, humidity etc data from MoES
O]	OCEAN STATE DATA						
39	Marine and Ocean Boundaries	Boundaries of EEZ, other marine assets etc	MoES	-	-	-	To be determined with MoES
40.	Ocean Data – PFZ, OSF	Ocean-state data	MoES	-	Update cycle to be worked out	-	Ocean state details from MoES
P]	PUBLIC-INTERFACE DATA						
41.	Crowd soured data	For public-feedback, complaints, events etc	-	From GPS-enabled mobile device	As and when required	Point-code	Details of Subscriber, inputs etc

SPECIFIC SECTORAL GIS CONTENT THAT CAN BE ORGANISED IN MINISTRIES FOR NATIONAL GIS APPLICATIONS (TENTATIVE; WILL BE UPDATED)

(DETAILS TO BE UPDATED/ADDED/OBTAINED FROM GOVERNEMENT AGENCIES - USER CONSULTATION)

No	National GIS Applications	Sectoral GIS content and linkage	POSSIBLE SOURCE	Linkages to GIS (GPS Point/Admin Unit)
1.	Rural GIS	All MoRD data with all programmatic and financial attributes linked to villages	Ministry of Rural Development	Villages
2.	Road-GIS	All road allocation, status and development attributes for PMGSY and all other schemes	NHAI/Planning Commission	Road
3.	Health-GIS	All attributes of hospitals, health centre and their usage	Ministry of Health & Family Welfare	Amenities data of health facilities
4.	Gyan-GIS	All education facilities and attributes of schools, colleges, universities and their related attributes	MHRD	Amenities data of school/edu
5.	Urban GIS	All urban data of all towns/cities, approved master plans etc	MUD	Settlements, Built-up
6.	Water-GIS	All sources of water - surface and ground-water, attributes of irrigation wells, programmes and sanctions, water budget estimates etc	MWRD	Drainage, Surface-water, Canals
7.	Agri-GIS	Data on agricultural facilities, banks, seed centres, advisories, plans and schemes etc	MOA/States	Amenities data of seed-centre, Land Ownership
8.	LIS	Cadastre data of ownership and other	MRD/States	Land Ownership

No	National GIS Applications	Sectoral GIS content and linkage	POSSIBLE SOURCE	Linkages to GIS (GPS Point/Admin Unit)
9.	DMA-GIS	All historical data of disasters, emergency data, all DM data and contact details, DM asset data etc	NDMA/States	Villages
10.	Power-GIS	Already being established by PFC	Ministry of Power	Utilities-Power
11.	Env-GIS	All data on environment, forest maps and attributes, pollution data points and attributes, global change etc	MOEF	Forest boundary, Pollution Points
12.	UID-GIS	Basic link of UID primary to coordinates and administrative maps	UIDAI	Villages
13.	e-Services of PIII	All e-services linkage to coordinates and administrative linkage	PIII	Villages, Amenities
14.	Planning Commission-GIS	All plan attributes of 11th plan, allocations, status, past plan allocations, status etc	Planning Commission	All layers
15.	Citizen Services	Basic POI data and other census and developmental data for citizen access	PIII and INGO	Villages, All layers

TABLE-5: NATIONAL GIS STANDARD
(Adapted from NNRMS Standards/NSDI Standards/SOIs 1:10K Mapping document)

DEFINITION OF A NATIONAL SPATIAL FRAMEWORK IS REQUIRED – A Standards India (nation) template (at 2-sclaes – 1:50K and 1:10k as of now) with Intl boundary, state/district/taluk boundaries (with standardized names) – freely and easily available as a National GIS Foundation Dataset. This could be used by one-and-all to create and organize mapping/surveying; GIS data and services.

No	Parameter (All values at 3σ)	National GIS Version 1.0 (1:50,000 FRAMEWORK)	Version 2.0 National GIS (1:10,000 FRAMEWORK)
	Recommended source for National GIS Activities	Satellite images/Mapping Agencies	Satellite images/Fresh Mapping
A	**NATIONAL GIS: SATELLITE IMAGE STANDARDS**		
1	Generic/Standard Resolution	5.8m XS or better	5.8m XS or better
2	IRS Image Resolutions recommended for National GIS activities	5.8 m XS supported by 5.8 m Pan / XS	2.5 m Pan fused XS
3	NSF	1:50K National GIS Foundation Dataset	1:10K National GIS Foundation Dataset
4	Projection for image outputs	Geographic	Geographic
5	Datum for image products	WGS 84	WGS 84
6	Image Frames (geometrically corrected; important for seamlessness)	Polygon	Polygons
7	Image Position (Planimetric) Accuracy (0.5 mm of scale) in m	25	5
8	Band-to-Band Registration for XS data (0.25 pixel) in m	~6	~1.5
B	**NATIONAL GIS: MAP STANDARDS**		
1	NSF	Nation/State	Nation/State
2	Minimum Map Frame size for incorporation	15' X 15'	3' 45" X 3' 45"

No	Parameter (All values at 3σ)	National GIS Version 1.0 (1:50,000 FRAMEWORK)	Version 2.0 National GIS (1:10,000 FRAMEWORK)
3	Image Registration accuracy @ 0.5 pixel (RMS)	12m	1.25m
4	Map Projection	Geographic	Geographic
5	Datum	WGS 84	WGS 84
6	Position (Planimetric) Accuracy (1mm of scale) in m	50	10
7	Minimum Mappable Unit (MMU) (3 x 3 mm of scale) in sq mts	22500	900
8	DEM Z-Spacing as 1mm of scale in m	50	10
9	DEM Z-Accuracy in m	10	5
10	Thematic Accuracy of Classification/Mapping	90/90	90/90
11	Map Formats	• Digital GIS compliant • Paper	• Digital GIS compliant • Paper
C	NATIONAL GIS: GEODATABASE STANDARDS		
1	Spatial Framework	Seamless - National	Seamless - National
2	Tie-Point Intervals for Spatial Framework	5' X 5' & 3' 45" X 3' 45"	45" X 45"
3	Coordinate units for Precision	Decimal-Seconds	Decimal-Seconds
4	Projection	Geographic	Geographic
5	Datum	WGS 84	WGS 84
6	Coordinate Precision	Single	Single
7	Minimum Frame size for NRR	15' X 15'	3' 45" X 3' 45"
8	GIS DB Tic Registration Accuracy (0.25mm of scale) (RMS) in m	12.5	2.5

No	Parameter (All values at 3σ)	National GIS Version 1.0 (1:50,000 FRAMEWORK)	Version 2.0 National GIS (1:10,000 FRAMEWORK)
9	Position (Planimetric) Accuracy (1mm of scale) in m	50	10
10	Coordinate Movement Tolerance (CMT) (0.125mm of scale) in m*	6.25	1.25
11	Weed Tolerance (WT) (0.125mm of scale) in m*	6.25	1.25
12	Sliver Polygon Tolerance (SPT) (LESS-THAN MMU) in m*	<22500	<900
13	Grid Size (for Image/Raster/DEM Layers) (0.5mm of scale) in m	25	5
D	NATIONAL GIS: OUTPUT STANDARDS		
1	Output Formats	• Portal GIS compliant • Digital publishing • Print	• Portal GIS compliant • Digital publishing • Print
2	Output Framework	• Admin Units – State, District, Taluk, Villages • Natural Regions • User defined region polygon • Spatial Framework grids • Ownership Reference	• Admin Units –District, Taluk, Villages • Natural Regions • User defined region polygon • Spatial Framework grids • Cadastre Reference
4	Output Projection	LCC / User defined	UTM / User defined
5	Output Datum	WGS 84	WGS 84
6	Output Formats	GeoTIF, TIF, Shape file, Jpeg, NSDE, pdf, png, GIS format	GeoTIF, TIF, Shape file, Jpeg, NSDE, pdf, png, GIS format

No	Parameter (All values at 3σ)	National GIS Version 1.0 (1:50,000 FRAMEWORK)	Version 2.0 National GIS (1:10,000 FRAMEWORK)
7	Output Symbology	As per Layer Legend	As per Layer Legend
8	National Spatial Framework Accuracy - Tolerable limits for area of standard admin units	<0.1% of state or district or taluk or tile areas	<0.1% of taluk or tile areas
9	Framework Verification • CMT and Weed Tolerance • Bound Box	 • <6.25 • As per1:50 NSF	 • <1.25 • As per 1:50 NSF
10	Position (Planimetric) Accuracy- Better than (Or Equal to) 1.5 mm of scale in m	75 Output to be sampled and certified for position accuracy quality	15 Output to be sampled and certified for position accuracy quality
11	Thematic Accuracy of Classification/Mapping	90/90 To be reported from Metadata	90/90 To be reported from Metadata
12	Minimum Map Unit (MMU) – Not Less than (Or Equal to) (3 x 3 mm of scale) in sq mts	22500	900
13	Scale Distortion Factor for Analog Outputs only – Not more than (Or Equal to)	3%	3%

TABLE-6: PERFORMANCE METRICS FOR NATIONAL GIS

PURPOSE	• Define a set of parameters that measure the success and performance of National GIS. These metrics would be monitored and evaluated by a process established within the National GIS Structure.
SCOPE	• Specific KPI for each major task of National GIS to be defined • Establish a process for measuring the KPI and report to higher level • Establish an incentivisation method to promote excellence. Identify under-performance for corrective action
IMPLEMENTATION	• National GIS Board to define metrics and values in advance and make it aware. • Assessment to be done with performing entity • Regular monitoring and corrective actions
PERFORMANCE METRICS	• Planning Com: Successful establishment of National GIS in 3 years; 12th Plan based on GIS; Ministries using GIS-based Planning and Governance • National GIS Council: Successful establishment of National GIS in 3 years; Ensure inter-ministerial coordination at ministerial level; Empower National GIS Board; Approve yearly plans of National GIS Board; Policy consideration/approval for further actions; Annual Review of National GIS/INGO • National GIS Board: Successful establishment of National GIS in 3 years; Hiring CEO, Sr Professionals in 1 month; Approvals Decisions in 15 days; Empowering CEO for operational implementation actions; Obtaining funds for programme; Policy positioning at high-level; Quarterly Review of National GIS/INGO • INGO: Successful establishment of National GIS Asset and National GIS Cloud; Ministry-wise GIS App services; National GIS Asset available for Government/Enterprise/Citizens; Best Procedures and Practices • Ministries: Establishment of Ministry-specific GIS App and its usage; 12th Plan proposals of Ministry on National GIS • CEO, INGO: Establishment of National-GIS Ver 1.0 in 6-9 months; Ver 2.0 in 30 months; Review Mechanism of operations • National GIS: Access metrics of National GIS Asset; usage metrics forgovernance/enterprise/citizen apps • INGO Staff: Specific task metrics identified by CEO • Contractors: Quality metrics; Schedule metrics; Delivery Metrics

TABLE – 7: PARAMETERS FOR NATIONAL GIS APPLICATIONS AND SERVICES STANDARD

A] GIS APPLICATION STANDARDS:

Parameter	Value (to be defined at implementation stage)	Remarks ((to be defined at implementation stage)
Web Servers		
Data Base Severs		
Application Servers		
Case Tools		
Development Tools		
Database Environment		
Spatially Enabled Databases		
Web Forms		
Reports		
APIs & Utilities (viz. Java)		
Web Mapping Framework		
Transformation and Coordinate System		
Web-GIS Framework		
Mobile Mapping Standard		

B] WEB STANDARDS:

Parameter	Value (to be defined at implementation stage)	Remarks ((to be defined at implementation stage)
Browser Standards		
Development Platform/Libraries		
HTML Standards		
Java Standards		
JavaScript		
Java Server Pages		
XML/GML/KML		
Web Server		

C] SECURITY:

Parameter	Value (to be defined at implementation stage)	Remarks ((to be defined at implementation stage)
Encryption		
VPN		
Digital Certificates		
User Authentication		
Cyber Security Auditing		

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GOVERNMENT OF INDIA
PLANNING COMMISSION
(S&T Division)

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Dated: 25.04.2011

OFFICE MEMORANDUM

Subject: Constitution of National GIS – Interim Core Group

Planning Commission is considering the establishment of a National GIS (NGIS), consisting of a nation wide, large scale maintainable GIS assets and GIS application services. This would be one of the core components of India's planning and would significantly support the national development process – especially in implementing spatial planning process. It would also help in monitoring and coordinating the developmental activities in the country.

2.   In this context, Planning Commission has constituted an Interim Core Group (ICG) of geospatial experts to start immediately the preparatory activities with the main purpose of preparing the foundation on which the full scale activities of NGIS can be taken up. This would entail preparing the necessary programmatic documentation, undertake larger consultation with the user agencies, data generating agencies, industries and academia and enable the Planning Commission to process the Cabinet approval. The Composition of the ICG and the Terms of Reference are as under:

3.   COMPOSITION

(i)   Dr. Shailesh Nayak, Secretary, Ministry of Earth Sciences – **Chairman**

Members:
(ii)   Dr. R. Sivakumar, CEO, NSDI/Head NRDMS, DST, New Delhi
(iii)   Dr. S. Subba Rao, Surveyor General of India, Dehradun.
(iv)   Dr. (Mrs.) Vandana Sharma, DDG, NIC, New Delhi
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(ix)   Shri C.R. Bannur, Regional Director, Rolta India, Mumbai
(x)   Shri Rakesh Verma, Managing Director, Map My India, Delhi
(xi)   Shri A.K. Verma, Adviser (S&T), Planning Commission, New Delhi
(xii)   Dr. Mukund Kadursrinivas Rao, Ex-President, GSDI Association/GIS Consultant), Bangalore – Member Secretary

4.   Terms of Reference

i)   To organise a broad based consultation process for obtaining/planning the best inputs for National GIS. The consultation will be steered amongst users of

1

National GIS (key central Ministries – Environment & Forests/ Agriculture/Rural Development/Water Resources/Urban Development/ Power/ Planning Commission; UIDAI and others; state government agencies; in government and private sector; GIS applications solution providers; academia and any other group that can contribute in the planning of NGIS. Ultimately, plan and implement a National GIS Workshop that will bring all the consultation process into a national discussion and strategizing for the National GIS.

ii) To prepare a "National GIS vision/Strategy" document that defines the strategy, plan and road-map for the National GIS and its implementation and its sustained success through appropriate public-private partnership.

iii) To define the broad contours of the National GIS Standards – by integrating the existing GIS experiences and standards and state-of-the-art in GIS Standardization into a formal National GIS Standard and process document.

iv) To support the Planning Commission in drafting the proposal on National GIS and Indian National GIS Organisation (INGO) for seeking necessary approvals of the Government such as EFC and the Cabinet.

v) To plan and prepare for formal launch of activities of National GIS at appropriate time.

5. The above preparatory activities for setting up of NGIS may be completed in six months time from the date of constitution of ICG.

6. The ICG will function under the overall guidance of Member (Science), Planning Commission. Member (Science) may assign additional tasks to the ICG as and when required.

7. Chairman, ICG may co-opt any other person as Member of the Group.

8. Ministry of Earth Sciences will service the Interim Core Group and provide the necessary logistic and administrative support for the activities of the ICG on behalf of the Planning Commission.

9. Planning Commission has approved a Budget Provision of Rs. 50 lakh under the Scheme "Plan Formulation, Appraisal and review" Scheme (Major Budget Head 93, Demand No. 74) of the Planning Commission, to meet the expenditure towards the preparatory activities of NGIS. Ministry of Earth Sciences is being authorized to operate the "Plan Formulation, Appraisal and review" Scheme (Major Budget Head 93, Demand No. 74) of the Planning Commission to the extent of Rs. 40.00 lakh during Annual Plan 2011-12, for servicing the ICG for undertaking the above mentioned activities.
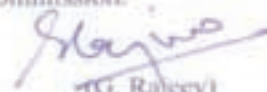
10. TA/DA to Official members of the ICG will be met by their respective Ministry/Department. In respect of non-Officials, TA/DA will be met from the Budget Provision of Rs. 40 lakh approved by the Planning Commission for servicing the ICG.

11. Ministry of Earth Sciences will incur expenditure to the extent of Rs. 40 lakh, for undertaking the above activities from the "Plan Formulation, Appraisal and review" Scheme

2

(Major Budget Head 93, Demand No. 74) of the Planning Commission, as per the authorization being given by the Planning Commission.

12.   Shri R.K. Gupta, Joint Adviser (S&T) is the Nodal Officer for the National GIS Interim Core Group and his Tel Nos. are 011-23096528, 09968288853, Email- rkgupta-pc@nic.in.

This issues with the approval of the Member Secretary, Planning Commission.

(G. Rajeev)
Under Secretary to Government of India

To:

Chairman and Members of National GIS ICG

Copy to:

1) Deputy Chairman, Planning Commission
2) Principal Secretary to Prime Minister
3) All Members of Planning Commission
4) Member-Secretary, Planning Commission
5) Cabinet Secretary to Government of India
6) Secretary, Ministry of Earth Sciences
7) All Secretaries to the Government of India
8) All State Chief Secretaries
9) DG, Unique Identification Authority of India
10) OSD to Adviser to PM on Public Information Infrastructure and Innovation (PIII)
11) All Principal Advisers/Sr. Advisers/Advisers/HODs, Planning Commission
12) Director(PC), Planning Commission
13) Administration (General-I) and (General –II), Planning Commission
14) PAO, Planning Commission
15) Accounts-I Branch, Planning Commission
16) Information Officer, Planning Commission
17) Library, Planning Commission
18) Planning Commission web-site

(G. Rajeev)
Under Secretary to Government of India

3

GOVERNEMENT OF INDIA
PLANNING COMMISSION
&
MINISTRY OF EARTH SCEINCES

REPORT OF NATIONAL GIS WORKSHOP

1. The National GIS Workshop was organized by Planning Commission and Ministry of Earth Sciences at India International Centre on September 14, 2011 The list of participants is given in **Annexure-1.**

2. The Agenda is given in **Annexure-2.**

INAUGURAL SESSION

3. Dr K Kasturirangan, Member (Science), Planning Commission welcomed the delegates to the workshop and traced the steps leading to the workshop. He mentioned that recognizing that GIS has a notable outreach for governance and national development, our Hon'ble PM posed whether it is not time for us to take the next step of enhancing the value of GIS to the nation by suitable technological, programmatic and organisational approaches. The Deputy Chairman of the Planning Commission asked some of us to take the vision of PM forward by setting up, as a first step, a national level Interim Core Group (ICG) under the Chairmanship of Dr Shailesh Nayak to examine the different elements and come out with a programmatic vision for National GIS. He noted that the GIS requirements were also discussed with Mr Sam Pitroda, who immediately envisaged GIS as an integral component of Public Information Infrastructure and saw the use of National GIS for public e-services.

Dr Kasturirangan went on to identify 3 important issues related to GIS – first, how can we ensure that our decision/governance system is supported by a comprehensive, easy-to-use GIS Decision Support System – whatever the DECISION-MAKER wants must be supported by GIS; second, how can any USER be rid of the "hassles" of GIS data organisation that he now faces – ensuring that GIS-Ready data is readily available; third, how can we have an institutional system in the country that is responsible for GIS and is accountable to meet the GIS needs of the country. He observed that to address these critical issues and to reach this stage of the National GIS Workshop, the ICG had now defined and detailed a Vision for National GIS and Indian National GIS Organisation (INGO) – which has emerged after a large amount of consultations. He mentioned that this Workshop has the major aim of debating and deliberating on the programmatic vision of National GIS that can fully contribute in meeting the challenges of governance and development in the country.

4. Mr Sam Pitroda appreciated the vision and concept of the National GIS and expressed support to the programme. He mentioned that India is at the cusp of another technological and development curve and in its drive for inclusive growth, social equity & development a major requirement would be to re-engineer many systems and processes. He mentioned that Information will be the 4th pillar of democracy and GIS will be that important element of the 4th pillar – helping in the concept of unified information infrastructures and bring one important level of unification and collaboration amongst many stake-holders. The Public Information Infrastructure (PII) had been envisaged to provide broad-band connectivity and a host of e-services to every citizen – be in urban or rural areas. He mentioned that PII aimed to be enabling repositories of citizen needs, geographical and physical characters of our country and programmes of government. He mentioned major technological thrust being taken up – first, the laying of a fibre-network for connecting 250k panchayats; establishment of the National Knowledge Network (NKN) and now the National GIS. He stressed the needs of standardization – even for National GIS and emphasized that creating national repositories will help governance onto a single information and decision platform. He also appreciated the concept of a separate organisation for GIS and noted that good leadership will be required to ensure success of INGO and National GIS.

5. Mr Montek Singh Ahluwalia, in his inaugural address, mentioned that India is on a path of progress and sustained growth all-round. He mentioned that in the 12th Plan, focus is on social and physical infrastructure with key areas being agriculture; manufacturing; infrastructure, rural connectivity, health and education services and addressing special challenges for vulnerable/deprived areas. He mentioned that the need and demand is for good governance – essentially for effective implementation of development and also in context of better functioning of government and private sector in the economy. He mentioned that GIS is an important technology area which can form the basis of a DSS. He highlighted that a national-level GIS that can serve multiple needs – government, enterprises and citizens and mentioned that National GIS must power more open government and, thereby, leverage economic and social development and reaching the gains of development to the most needy and at the right place. He noted that GIS must also aim to bring accountability and responsibility of public activities where decision-making can be centered around GIS – thus factoring location and time-domain map information. Noting that National GIS will be one capability that can support the nation, he highlighted how spatial planning and determining options and alternatives for planning will become important. He mentioned that a visual display or an image speaks volumes and makes easy understanding as against words and figures. Citing examples from his experience on how satellite images and maps helped in determining changing scenario over time, he also mentioned that by being able to now put amenities and even citizen data on maps can make a differentiator in understanding disparities and gaps in development. He mentioned that National GIS must also help monitoring programmes and schemes – provide multi-tiered perspectives for various levels of decision-

making. Justifying the support for investment for National GIS, he observed that over the years, India has already made considerable investments to develop individual elements of space-based imaging, mapping systems, informatics systems etc and these have created the basics but now the National GIS will add that key but small value-addition to bring modernism and technological thrust into the realm of decision-makers and be a differentiator for planning and development. He mentioned that India must has the technological capabilities to establish the National GIS and be at the forefront in the GIS arena – though our challenges and our needs of GIS would be very different from what some other nations are doing. He mentioned that Indian government would like to use National GIS throughout its many ministries, agencies and departments and because of its integrative capability, GIS technology can uniquely provide a "collation" to the diverse and complex operations of the national and state government activities. He hoped that within Planning Commission, he would like to see planning, monitoring and reviewing of the next Annual- Plan exercise done on the National GIS, apart from generating the 5-Year plans, macro- and micro-indicators of developments as inputs on the National GIS platform. He expressed full support from Planning Commission for the National GIS and expressed happiness at the Vision that has come to a mature stage of readiness. He appreciated the intense collaboration that has been done by ICG and expressed the hope that soon Planning Commission would be able to take up the approval related activities for the National GIS.

6. Dr Shailesh Nayak gave an overview of the envisioning exercise for the National GIS and INGO and outlined the 3-tiered process that was adopted for generating the National GIS programmatic vision. He mentioned that in 2010, the Internal Planning Commission had considered the need National GIS and had recommended that this should be taken up for detailed programming. Subsequently, a few Secretaries of GOI (DAC, DST, MoES, MoWR, MUD, MoEnF, Chairman, PIII, Chairman, UIDAI etc) were consulted and a background document on National GIS had been organized by Planning Commission. He mentioned that after Planning Commission constituted the ICG in April, 2011, the ICG considered the background document prepared by Planning Commission on National GIS and very quickly the experts in ICG prepared a Ver 1.0 of the National GIS/INGO programme vision document and the same was circulated to government users, industries, academia/NGOS. Detailed consultation meetings were held with government agencies where ~34 ministries/departments participated; GIS industry and industry association where ~38 industries participated and with academia/NGOs where ~12 agencies participated. A detailed consultation with Planning Commission Advisers was also held. Based on all these consultations and inputs/suggestions received by ICG, a Ver 2.0 of the programmatic vision for National GIS/INGO was prepared by ICG. This had been circulated to all government ministries/departments, industries, academia/NGOs and is to be discussed in this National GIS Workshop. He mentioned that any final inputs/suggestions from this Workshop would again be considered by ICG and a final version of National GIS/INGO programmatic vision prepared. This would be submitted to Planning Commission by end

September, 2011. He mentioned that National GIS has the main aim of thrusting the use of GIS applications in governance/planning/development activities. He mentioned that GIS is of great relevance for many government activities, enterprises and for citizen services. While India has made some progress in using GIS, a national system of a GIS is very important and timely for the nation to adopt. He mentioned that an organisation focus on GIS is required and ICG has envisioned an agile, re-scoping organisation – Indian National GIS Organisation (INGO).

7.   Dr Mukund Rao made a presentation on the vision and programme elements of National GIS and INGO. He observed that the economic and development growth in coming years would demand a significant change in planning and governance in the country with stringent demands on moving from the traditional allocation systems to determining equitable systems and a scientific mapping of the needs/aspirations/desires and limitations of the beneficiaries and society. He noted that India will require a vastly different information regime to arm itself for meeting the above challenges of a trillion-level of economy and justified one such area is a National Geographical Information Systems (GIS) – a GIS based Decision Support System (DSS) for better governance and development support, private enterprise growth and also for citizen's access. Emphasizing the elements of a state-of-art National-level GIS infrastructure, a National GIS Asset of ~41 layers of information (from available maps, satellite images and geo-tagged tables and crowd-sourced data), a suite of ~28 GIS DSS Applications service for governance and public services, the concept of a National GIS Portal and the need for GIS capacity-building, Dr Rao addressed the importance and need for an integrated National GIS policy. He also outlined the justification for a new organisation responsible for National GIS and outlined a possible framework of INGO – the organisational frame for National GIS – basically as an agile and flexi-mission-oriented organisation. Dr Rao also outlined the systematic process that was adopted through ICG for wide consultation on the National GIS/INGO programmatic vision with government users, industries, academia and NGOs and mentioned that almost 90+ inputs/suggestions had been received and addressed by ICG in the 3-tiered consultation process reaching upto this Workshop.

8.   Dr Rao proposed the Vote of Thanks for the Workshop.

NATIONAL GIS TECHNCIAL SESSION

9.   Mr Arun Maira, Member, Planning Commission, in his remarks as Chair, mentioned that National GIS is an important requirement and expressed satisfaction that a separate organisation focus has been addressed. He mentioned that a strategic way at organisation development is required and we must shun the tradition bureaucratic level-creating organisational frames but make it more networked and performance oriented. He stressed the need for defining decision-rights and also the importance of right leadership way forward for success of INGO. He endorsed the way INGO had been envisioned and supported its framework and

agility and re-scoping concept. He said efficiency is in leveraging strengths and that is what INGO should do.

10. The following key presentations were made by ICG Members detailing elements of National GIS:

- National GIS Asset including 1:10k Mapping: Dr Subba Rao, Surveyor General, SOI made a presentation on details of National GIS Asset. He mentioned that 2 levels of GI Asset would be organized – one equivalent to 1:10k data and city-wise data at larger scales. He mentioned that ~41 features had been identified for National GIS Asset apart from almost 19 ministries sectoral data which would be geo-tagged. He mentioned that SOI would immediately take up Ver 1.0 of National GIS Asset using 1:50k framework and whatever data is available with SOI and others. Subsequently, in Ver 2.0 the Asset would be upscaled to 1:10k based on 1:10k base map that SOI would be generating. He outlined SOI plans for 1:10k large scale mapping by which SOI would prepare 1:10k maps using satellite images and limited field observations. He said that this would take SOi 3 years of work but it would help populate considerable content to National GSI Asset at large scales.

- Towards National GIS Standards: Mr Shantanu Bhatwadekar, Dy. Director (EOS), ISRO Hq made a presentation on National GIS Standards and also outlined how these have been evolved. He mentioned that ICG had identified the importance of Standards and mentioned that they would be open and inter-operable standards at data level and also at applications levels and that they would be neutral to technology and platforms. He mentioned that about 8 Standards would get identified and also about 12 processes would get standardized for National GIS. He detailed the foundation of NNRMS and NSDI Metadata/Exchange Standards – which was widely adopted and prevalent in ministries/departments/states/private sector for GIS data. He mentioned that the NNRMS Standards not only identified image/mapping/database standard parameters but also identified schema which can be adopted for National GIS. It was envisioned to align India's GIS Standardisation activities to ISO-TC211 through link BIS Committee on GIS Standards – apart from having a technical experts committee for reviewing/modifications of National GIS Standards.

- GIS Applications Services and Portal: Dr Vandana Sharma, DDG, NIC outlined how NIC has developed a seamless dataset by integrating various data sets (SOI maps, administrative units, landuse, soils, land degradation, images etc) from different organisations into a single frame. NIC also has utility mapping for 6 cities in GIS format. This data frame is providing NIC the base for GIS application services that is served through the internet cloud using ArcSDE engine and Postgis/Oracle database engines. The NIC GIS Portal is mainly available for G2G services and provides mashup interfaces to Bing, Google and other services. The seamless database is adapted at 12 tiled-

levels to get depth of scale-view. The GIS apps for mapping post-offices, demography, amenities, Delhi Sports, Election activities etc are available as web-enabled GIS Apps. Dr Sharma emphasized that National GIS applications are to be based on Service Oriented Architecture (SOA) and have modules that support flagship programmes like NREGA, DDWS etc. She also mentioned that concept of Cloud-GIS needs to be explored and mentioned that INGO would provide the right directions for extending the scope of GIS at national level.

• Indian Tsunami Early Warning System: Dr Satish Shenoi, Director, INCOIS made a presentation of an important GIS Apps related to Tsunami Warning System that is operational as a web service on a dedicated high-end infrastructure in INCOIS. He mentioned that real-time data on earthquakes are collected and so are data from ocean-bottom pressure sensors to detect tsunamis. These are modeled with past database and Indian region GIS data to predict tsunami warning almost in real-time basis. He gave examples of how this GIS based system has been much advanced to contemporary tsunami warning systems in the world. This example was an illustration how the 25+ GIS DSS Apps would function for various ministries/departments.

• INGO – The Organisational Frame: Mr K R Sridhara Murthi, Sr Expert, PIII made a presentation on the organisational framework of INGO. He justified the need for an organisational focus for National GIS through INGO and mentioned that GIS has large national and global implications and its development and services requires an organisational focus. He emphasized that the present project focus was not delivering the results of GIS services for users though it was adding to national capability. He mentioned that INGO would have a clear mandate and responsibility for GIS in India and be responsible for National GIS. The INGO would be an agile and slim organisation – re-scoping itself for various stages of National GIS. INGO would mainly get tasks done through efficient involvement of private sector and would enable a eco-system that would be conducive to GIS growth. He outlined the structure of INGO with an apex council, an empowered board and a task-oriented CEO with teams of performance oriented staff. Thus, INGO would draw best from both world – check and balances of government system and efficiency of private sector to be successful. INGO and National GIS activities would have clearly defined KPI and performance metrics to measure performance and achievement at all levels.

• Capacity-Building for National GIS: Prof N L Sarda, Professor, IIT-Bombay made the presentation on the envisioning for capacity-building for National GIS. He outlined the 4 pronged approach for capacity building – at school level, at university level, at professional training level and need for a knowledge-level national centre for GIS research and education planning. He mentioned that one major need for National GIS is the training of a large number of users in ministries/departments/private sector rtc who would use and benefit from National GIS. This is important for success of National

GIS. He stressed that GIS is inter-disciplinary and at University level this concept has to set in (like in other nations). He highlighted the advanced research needs especially in interoperability, ontology, data exchange relays and also in standardization. He outlined some of the research being done in other nations and stressed that National GIS vision must include a focus on research and education.

11. Mr Kiran Karnik, Co-Chair for the session delivered the concluding remarks and mentioned that National GIS is a major national effort and urged for its implementation at the earliest. He endorsed the envisioning of the National GIS vision and mentioned that though the data is of sovereign nature the capacity of industries must get utilized to a large extent. He also urged that flagship schemes of government – NREGA, JNNURM etc must be based on GIS foundation. He mentioned that the challenge is in the organisational development of INGO and this needed extensive technical, visionary and leadership capabilities in the CEO. He also suggested that a business model must emerge for the National GIS and policies for this must get positioned.

NATIONAL GIS USER NEEDS SESSION

12. Ms Sudha Pillai chaired this session and called for presentation to focus on user needs. She highlighted that GIS is yet to make a place in planning though the nation has considerable technical capabilities in GIS and various projects have been implemented. She endorsed the need for National GIS and mentioned that the need is to make it a part and parcel of planning and development within government.

13. The following key presentations were made by ministries/department detailing GIS App needs and their present level of GIS activities:

-   Ministry of Panchayati Raj: Mr Sushil Kumar outlined the activities of MOPR and how panchayat requirements are for project monitoring, connectivity, infrastructure, e-services etc and there are 12 core modules of e-panchayat services envisaged. GIS is an important module in this accounting process for panchayat development and is essential to view a spatial map of panchayat resources, programme and plans implemented/to be implemented and what is required apart from grievance redressal applications. He mentioned that a National Asset Directory in GIS format is required accounting all assets that are created using public funds with all their details. He also mentioned the need for social audit of panchayats to be depicted on GIS.

-   Dr Malaviya mentioned about the activities of GSI and the organisation of the GSI Portal of GIS services. He highlighted the extensive efforts undertaken by GSI for creating GIS records of its geological information and how these are available in query services. The GSI Portal has been developed using ArcSDE technology using Oracle database engine. The Portal provides basic map services, atlas services and user-defined search on GSI data. The future plan is for enhancing web-services linked to National GIS and also development of an on-line core business process system for GSI.

- AP State: Dr Mryuthunjaya Reddy presented on the GIS Applications that AP State has positioned on a state-wide GIS data that has been organized. A state-wide seamless GIS has been organsied based on use of satellite images and contained various layers. Dr Reddy mentioned that this is allowing visualisation of natural resources data on administrative units and visualise upto village-level. He mentioned how GIS Apps for flood forecasting have helped AP to take correct decisions on evacuation and relief management – especially in Krishna floods of 2009. He outlined GIS Apps of watershed management, assembly constituency management, soil data management, irrigation command area management, cropping pattern analysis,

- Gujarat state: Mr TP Singh showed how Gujarat had developed a 140+ parameter seamless GIS database using satellite images and which was correlated to various administrative hierarchies – thus allowing visualising administrative data on natural features and natural resources data on administrative units. He showed specific examples of GIS based DSS for MNREGS and village-level amenities planning that has been developed and used in Gujarat. GIS Apps for site selection, watershed management, coastal management, departmental planning etc have been developed. Specific GIS DSS for road infrastructure assessment at village level, irrigation management, urban areas management, forest management etc were also highlighted by Dr Singh. He emphasized the need to keep the National GIS simple for users to use, build easy-to-use applications and constantly update the GIS database to keep it current.

- MoEnF: Dr Subramanyam presented the GIS Apps of MoEnF and the future needs. He mentioned that maps have been prepared on coastal areas, snow and glaciers, desertification mapping, wetland mapping etc under NNRMS; bi-annual Forestry Mapping is carried out by FSI; Zoning Atlas for Siting of Industries has been prepared; mapping of Ecologically Sensitive Areas – Example of Western Ghats and establishment of Environmental information Centre. He also highlighted a Wetland Information System developed and National Coastal Information System using GIS. He mentioned that MoEnF envisaged a GIS DSS for other areas like Pollution prevention, control and abatement; Environmental impact assessment; Hazardous and solid waste management; Forest conservation and protection; Bio-diversity conservation and sustainable use; Wild life protection; Climate change; Wetland conservation and management; River conservation and Desertification and for functional processes of MoEnF.

14. Dr Shailesh Nayak concluded this session by highlighting the need for clearly defining GIS DSS design for various ministries/departments and citizens. In this connection, ICG has broadly obtained inputs and consulted with various ministries to broadly define the GIS DSS functionalities and INGO would have to further discuss with each ministry to work out various details at time of implementation.

NATIONAL GIS OPEN HOUSE SESSION

15. In this session, inputs/suggestions were sought from participating delegates. The various inputs/suggestions received from delegates is given below:

- Dr PK Srivastava, DSSDI mentioned that large scale data (say 1:1000 scale) is very dynamic and poses quite a challenge to capture its latest currency. He also suggested that it would be good to keep simple GIS applications to decision-makers. The GIS DSS must serve different verticals in governance.

- Mr AR Dasgupta, Scanpoint Geomatics mentioned that GIS Data must not become a commodity but emphasis must be on GIS Data as a service; Standards must adopt inter-operability like OGCs GML; need for Data Delivery Standards. He also mentioned that GIS DSS must be left to users and must not get defined by INGO and observed that a "centralization" concept must not become a drive in National GIS. He suggested that INGO must be an enabling organisation and must not attain a regulating role.

- Dr Munshi, OGC-India mentioned that the need for adopting OGC standards seems to be under-played and is mentioned in brackets and mentioned that National GIS could benefit from already existing OGC Standards. He mentioned that the Table-5 on Standards is really not "Standards" but are basically image/mapping specifications. He also suggested that the National GIS Standards committee could also have international experts. He also noted that the Table-4 is a GIS content list and there has to be standardization for the Content. He also suggested that Defence GIS Apps must get included.

- Prof Rajan, IIIT-Hyderabad mentioned that efforts must be to remove phobia of technology as this hinders wider acceptance. He called for research areas to be clearly defined and suggested that INGO must also maintain a national repository of sw/apps/tools that are developed as this would help in knowledge-base archival INGO

- Anirudha Roy, Navayuga mentioned that it is essential to include Defence GIS Apps and also suggested that Data schemas must get clearly defined in Standards document. He also suggested that Citizen GIS Apps to be made easy (as in Google).

- Dr Baveja, Ridings congratulated for an excellent National GIS vision. He mentioned that clear standards must get defined for accepting data into GIS Asset. He wondered whether INGO can also undertake certification for GIS services of service-providers and enable a quality-culture in the eco-system. He called for INGO to also define PPP norms. He suggested that accuracy for standards to be at 3-sigma level and emphasized that GIS Standards are essential but not become obsessive and also observed that NRIS/NNRMS/NUIS standards (that is defined in Table-5) have served a good purpose in the country.

- Dr Vinod Bothale, MRSAC mentioned that there is a need for GIS App tool-box concept and also suggested self-maintained GIS database updation tools – making attribute data updation easy and part of governance process.

- Mr Jitendra, a NGO mentioned that National GIS would have to plan for multi-language display and suggested that trans-literation standards must get defined. He also suggested that metrics for success in GIS usage in public activities/governance/ citizens must get defined to determine success criterion of usage and impact. He also suggested that there is a need for freely available templates for users to create GIS-Ready data so that their data can get integrated into National GIS easily.

- Mr Vijaykumar, TCS suggested that it is important to position GIS data as a web-Service and noted that this is already included for in Vision document VEr 2.0. He also mentioned that GIS services would ultimately have to dove-tail with other services as part of an enterprise solution and this must be included. He also suggested that Citizens GIS Apps be included in Ver 1.0 of National GIS as they can make an immediate impact.

- Dr Milap Punia, JNU mentioned that GIS must get embedded into integrating it for central governments flagship social schemes; spatial governance/decentralized governance and participatory democracy need to get wider acceptance and usage and special efforts must be made to make them impacting. He also called for inclusion of research in social aspects of GIS.

- Mr Nikhil Kumar, NIIT-GIS mentioned that if the GIS Apps of AP/Guj and other states are up-scoped they can become quick results for GIS DSS in National GIS. He also mentioned that technology will be key in defining the characteristics of National GIS.

- Mr Anil Kuar, MOD mentioned that Defence agencies may want access to National GIS Asset and this needs to be considered. He also noted that Defence has its own GIS Apps and these are available in MOD but challenges of GIS-Ready data also exists in MOD.

- Ms Dipti, Ministry of Panchayati Raj observed that National GIS is most important and observed that at panchayat level GIS for health/education facilities and many services need to be monitored. She wanted to know how correctness/Validation of data in National GIS would be assured as it derives various inputs. To this, Dr Mukund Rao clarified that the correctness/accuracy of data is mainly defined by its generation process which is included in GIS Metadata. Another aspect is correctness/accuracy as it is ingest in National GIS – for this National GIS Ingest Process and National GIS QA/Qc Standard would ensure that no degradation happens due to ingest process. Further, INGO could even position third-party independent verification to assess correctness/verification.

- Dr Anjana Vyas, School of Planning mentioned that sustainability of career for future students is essential. She also emphasized the GIS education and research focus and mentioned that a thrust for capacity-building must be initiated.

16. Dr Shailesh Nayak thanked the delegates for their inputs/suggestions and mentioned that ICG would consider these inputs and appropriately include in Final Version of Nationa GIS programmatic vision, as required.

HIGH LEVEL PANEL DISCUSSION: WAY FORWARD FOR NATIONAL GIS

17. The last session was a Panel Discussion where Dr Kasturirangan, Dr Shailesh Nayak and Dr T Ramasami gave their views on way forward for National GIS.

18. Dr Shailesh Nayak summarized the day-long proceedings and noted that while a broad endorsement for the vision has been obtained, the ICG would consider views expressed and inputs from this workshop and would quickly formalize the final version of the programmatic Vision of National GIS/INGO so that it can be formally submitted to Planning Commission. He mentioned that the challenge that he saw ahead was on building the institution of INGO – which is not just a necessity in present time-frame but also the key-element for the success of National GIS. He noted that INGO has to serve as the "anchor" aligning all varied elements of technology, requirements, agencies, programmes and even individuals to make the platform of National GIS a reality.

19. Dr T Ramasami made very open and transparent observations on the way forward. He mentioned that National GIS is a foregone realistic requirement – it is obvious that the national would benefit considerably by the establishment of National GIS. He also agreed that an institutional framework for National GIS is also a necessity and that INGO must be the anchor to make National GIS successful. He mentioned that the success of National GIS will be when GIS becomes a part and parcel of decision-making and all efforts must be in that direction. He mentioned that a dis-passionate view must be taken while institutionalizing INGO – especially on how it integrates with various agencies and existing mechanisms. He expressed satisfaction that INGO was being envisaged as a small, agile and re-scoping organisation and mentioned that it is time to get away from "permanency" of organizations. He mentioned that smaller organisations can be more effective – not just for themselves but also in the eco-system – as they have no heritage and background. In this connection, he mentioned that he has begun an exercise at re-shaping SOI – towards making it more responsible and accountable for its activities to the people's needs and meeting government requirements. Towards this, he observed that INGO can help bring that transformation to existing systems (like SOI) so that they would be more responsive and technologically forward-looking. He extended fullest support of DST for National GIS and mentioned that he would further work with Dr Kasturirangan and would support any initiatives that may be required for strengthening the GIS support to the nation.

20. Dr Kasturirangan invited Dr Jack Dangermond to make brief remarks – especially as he was present for the briefing meeting on GIS to Hon'ble PM last year – after which the National GIS

activity was taken up by Planning Commission. Dr Dangermond highly appreciated and lauded the vision of National GIS and mentioned that it was one of the most unique programme that he had seen. He noted that the National GIS is a system of systems and an application oriented DSS. He suggested that no self-optimisation must happen – like, the aim is not Standards but a GIS; accuracies can never get achieved but pragmatic progress is essential. He also suggested that evolve the system – the sub-elements are all envisioned well and let the system grow. He also suggested that it is important to focus on the main aim – GIS DSS for governance, enterprise and citizens – he suggested that a "killer App" could be to use National GIS to determine spatialisation of funds allocated/spent and let citizens make an assessment on this. He mentioned that the concept of INGO is unique and it must be a service-driven organisation and not become technology-driven. On the whole, he appreciated the Vision document and the way forward actions.

21. Dr Kasturirangan mentioned that now that the vision has been discussed and debated the key actions must be towards institutionalizing National GIS. He also mentioned that all round support for National GIS has been forth-coming and he urged the ICG to quickly finalise the programmatic vision documents so that Planning Commission could take up next steps of obtaining approvals. He expressed his agreement with Dr Ramasami that the organisation of INGO must be positioned rightfully and noted that there are just few possibilities that merit consideration. He mentioned that the characterization of INGO has been well written in the document but the key issues is to enable the network of linkages that INGO will build upon with various entities. He also agreed with Dr Ramasami that smaller organisations are more effective and that they can, in fact, trigger changing environment to larger entities and influence efficiency and performance. He mentioned that Planning Commission would take up the next steps of approvals and institutionalizing National GIS. He thanked Dr Nayak, Dr Ramasami and all delegates for participating in the Workshop.

22. This record issues with approval of Chairman, National GIS ICG and Member (Science), Planning Commission.

(Mukund Rao)
Member-Secretary, National GIS ICG
September 21, 2011

ANNEXURE-1: LIST OF PARTICIPANTS IN NATIONAL GIS WORKSHOP

DISTINGUISHED DELEGATES

1. Dr Montek Singh Ahluwalia, Deputy Chairman, Planning Commission (dch@nic.in)
2. Mr Sam Pitroda, Adviser to PM on IT, Innovation and Infrastructure and Chairman, National Innovation Council (s.pitroda@nic.in)
3. Dr K Kasturirangan, Member (Science), Planning Commission (k.rangan@nic.in)
4. Mr Arun Maira, Member, Planning Commission (arun.maira@nic.in)
5. Ms Sudha Pillai, Member-Secretary, Planning Commission (secypc@nic.in)
6. Ms Syeda Hamid, Member, Planning Commisison
7. Mr T Chatterjee, Secretary, Ministry of Environment and Forests (t.chatterjee@nic.in; titichatterjee@gmail.com)
8. Dr T Ramasami, Secretary, Department of Science and Technology (dstsec@nic.in)
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NATIONAL GIS INTERIM CORE GROUP

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ANNEXURE-2

GOVERNMENT OF INDIA
PLANNING COMMISSION
&
MINISTRY OF EARTH SCEINCES

NATIONAL GIS WORKSHOP

VENUE: INDIA INTERNATIONAL CENTRE
SEPTEMBER 14, 2011 (0900-1815)

0900 – 1000	Registration (Tea/Coffee will be served)
1000 – 1115	**INAGURAL SESSION** • Welcome by - Dr K Kasturirangan, Member (Science), Planning Commission • Address – Mr Sam Pitroda, Adviser to PM on Public Information, Infrastructure & Innovations (PIII) • Inaugural Address – Mr Montek Singh Ahluwalia, Deputy Chairman, Planning Commission • National GIS Visioning Exercise - Dr Shailesh Nayak, Secretary, MoES/Chairman, ICG **PRESENTATION ON NATIONAL GIS** (by Dr.Mukund Rao, Expert in Planning Commission on National GIS and Member Secretary, ICG)
1115 – 1130	Tea/Coffee
1130 – 1300	**SESSION – I: TECHNOLOGICAL AND ORGNISATIONAL ELEMENTS OF THE NATIONAL GIS** Co-Chair: Mr Arun Maira, Member, Planning Commission Co-Chair: Mr Kiran Karnik, Member, National Innovation Council Rapporteur: Mr Ajit Verma, Planning Commission • National GIS Asset including 1:10k Mapping - Dr Subba Rao, Surveyor General, SOI • Towards National GIS Standards - Mr Shantanu Bhatwadekar, Dy. Director (EOS), ISRO Hq/Dr R Sivakumar, CEO, NSDI • GIS Applications Services and Portal - Dr Vandana Sharma, DDG, NIC

	• Indian Tsunami Early Warning System – Dr Satish Shenoi, Director, INCOIS • INGO – The Organisational Frame - Mr K R Sridhara Murthi, Sr Expert, PIII • Capacity-Building for National GIS - Prof N L Sarda, Professor, IIT-Bombay
1300 – 1400	Lunch
1400 – 1515	**SESSION – II: GIS DECISION-SUPPORT AND USER NEEDS** Chair: Ms Sudha Pillai, Member-Secretary, Planning Commission Co-Chair: Dr Shailesh Nayak, Secretary, MoES/Chairman, National GIS ICG Rapporteur: Dr R Sivakumar, CEO, NSDI • Department of Agriculture and Cooperation • Ministry of Rural Development • Ministry of Panchayati Raj – GIS Needs: Shri Sushil Kumar, JS (e-Panchayat) • Ministry of E&F requirements of GIS: Dr Subramaniam, Adviser, PCCF-MP • Ministry of Road Transport and Highways - Shri R.P.Indoria, DG (Road Development) & Special Secretary • AP State GIS: Dr Mruthyunjay Reddy, Director, APSRAC • Gujarat State GIS: Dr TP Singh, Direct General, BISAG
1530 – 1615	**OPEN HOUSE/ INTERACTIONS:** Chair: Dr Shailesh Nayak, Secretary, MoES/Chairman, National GIS ICG Rapporteur: Dr Mukund Rao, Expert in Planning Commission on National GIS and Member Secretary, ICG
1615 – 1630	Tea/Coffee
1630 – 1730	**HIGH-LEVEL PANEL: WAY FORWARD FOR NATIONAL GIS** Chairman: Dr K Kasturirangan, Member (Science), Planning Commission Panelists: Dr T Ramasami, Secretary, DST Dr Shailesh Nayak, Secretary, MoES Concluding Remarks: Dr K Kasturirangan, Member (Science), Planning Commission

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This document has been prepared by the National GIS Interim Core Group (ICG) and has been finalized after an initial draft version was prepared based on discussions/consultations with government, industry and academia/NGOs and later a final draft was discussed at a National GIS Workshop held on September 14, 2011.

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